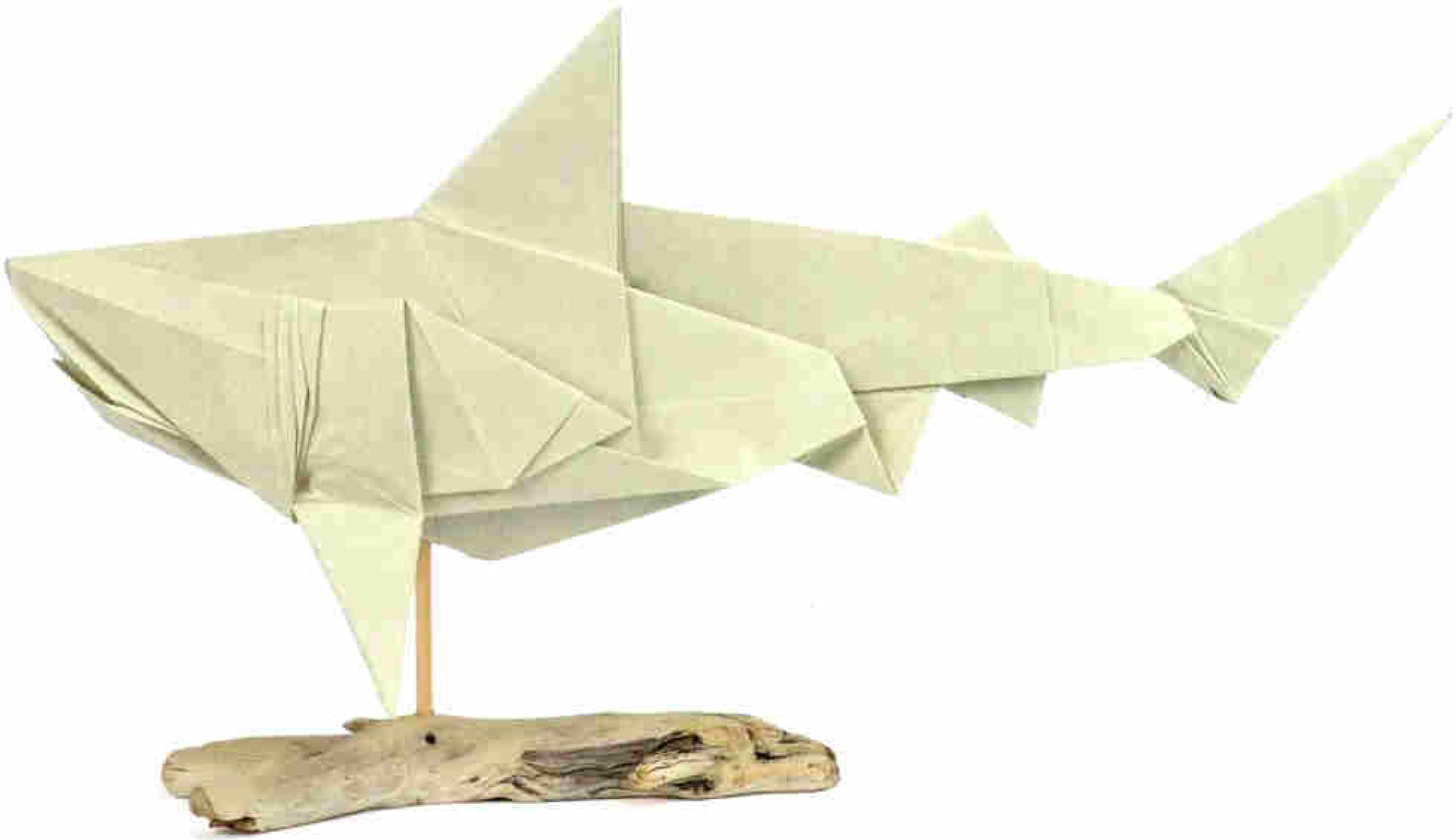
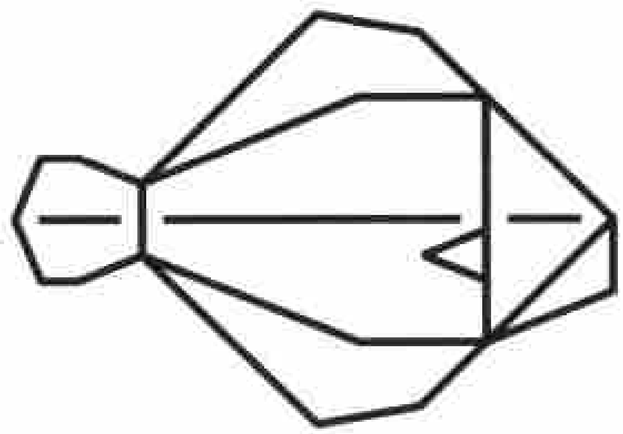
MARINE ORIGAMI

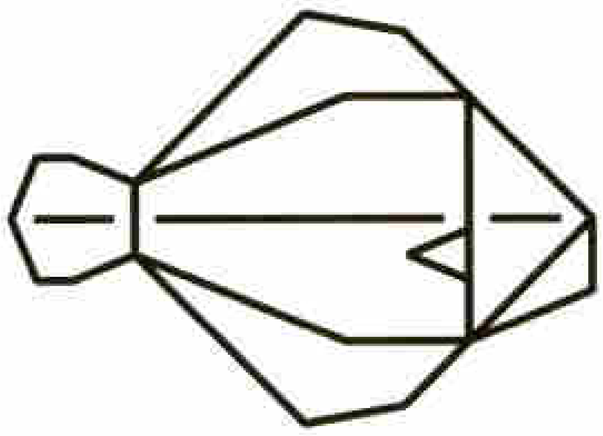


Joseph Hwang

ARTIST JOSEPH HWANG has harbored a deep fascination with marine biodiversity since he was a child. Alongside this passion was an interest in folding origami that transitioned from folding traditional models into a singular focus on creating his own designs. Inevitably, these two passions collided in his first series of figurative sea life designs, which comprise this book.

From innovative locking techniques to refined shaping methods, *Marine Origami* presents, through photography, essays, and step-by-step diagrams, twenty-six original models inspired by the diversity of coastal marine life. Ranging from minimalistic squid to lifelike dungeness crab, this carefully selected collection of models elevates the standard of figurative origami design.





MARINE ORIGAMI

Joseph Hwang

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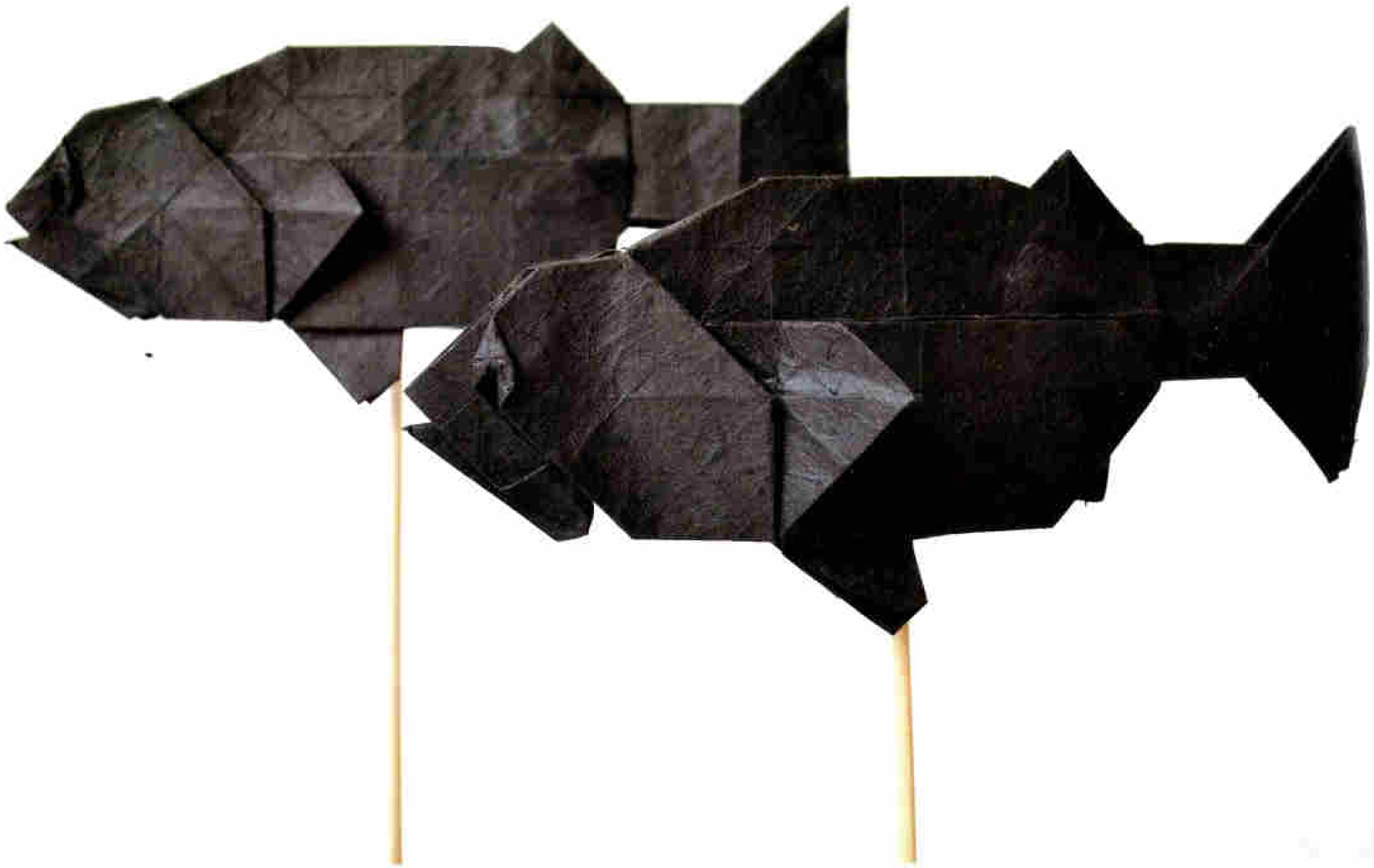
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Introduction

Twenty feet under the surface of the ocean, I was holding my breath, floating between the kelp. Suddenly, a large outline of a massive sea creature emerged from the depths. A fish, weighing at least three hundred pounds, swam towards me. Fear changed into awe. And as quickly as the fish appeared, it was gone. That was my first encounter with a giant sea bass, a large endangered fish native to the California coast. As a child, I spent numerous days at the beach exploring tidepools and piles of kelp that washed ashore. I loved catching shore crabs, prying open kelp holdfasts, and lifting algae-covered rocks to see what interesting animals dwelled underneath. As the years went by, this fascination for marine biology grew, and by high school I became an avid ocean diver.

Compared to urban areas where animal life is scarce, the ocean is bursting with abundant biodiversity. A single shore dive can reveal dozens, if not hundreds, of unique species: crustaceans, fish, mollusks, and more. These experiences have opened my eyes to the amazing complexity of marine ecosystems. However, they have also allowed me to witness firsthand the alarming changes that have happened and continue to happen within our generation, from kelp forest loss and sea urchin barrens to coastal eutrophication. As a diver, I am profoundly appreciative of the beauty of life in our oceans, but also deeply concerned about how our various activities are affecting it and the planet.

Folding origami has been a pastime throughout my childhood. In the early years, I mainly folded simple traditional designs or paper airplanes. Later on, I came across books such as *Animal Origami for the Enthusiast* and *Origami Sea Life*, which introduced me to a variety of figurative animal designs. But while I enjoyed folding, origami was just one of many activities I participated in.

In the summer between fifth and sixth grade, my family went to Australia to visit my grandparents. It was during those two long months that I discovered the world of super complex origami from designers such as Satoshi Kamiya. With a lot of time to spare, I spent numerous hours each week folding models with whatever paper I could obtain. It was there that I also designed my first figurative models. After the trip, my passion for folding and designing origami continued through middle school. However, once high school started, I took a long hiatus from folding. It was not until my senior year that I rediscovered my love of origami. Inspired by my experiences in the ocean, I began designing the series of sea life models which comprise this book.

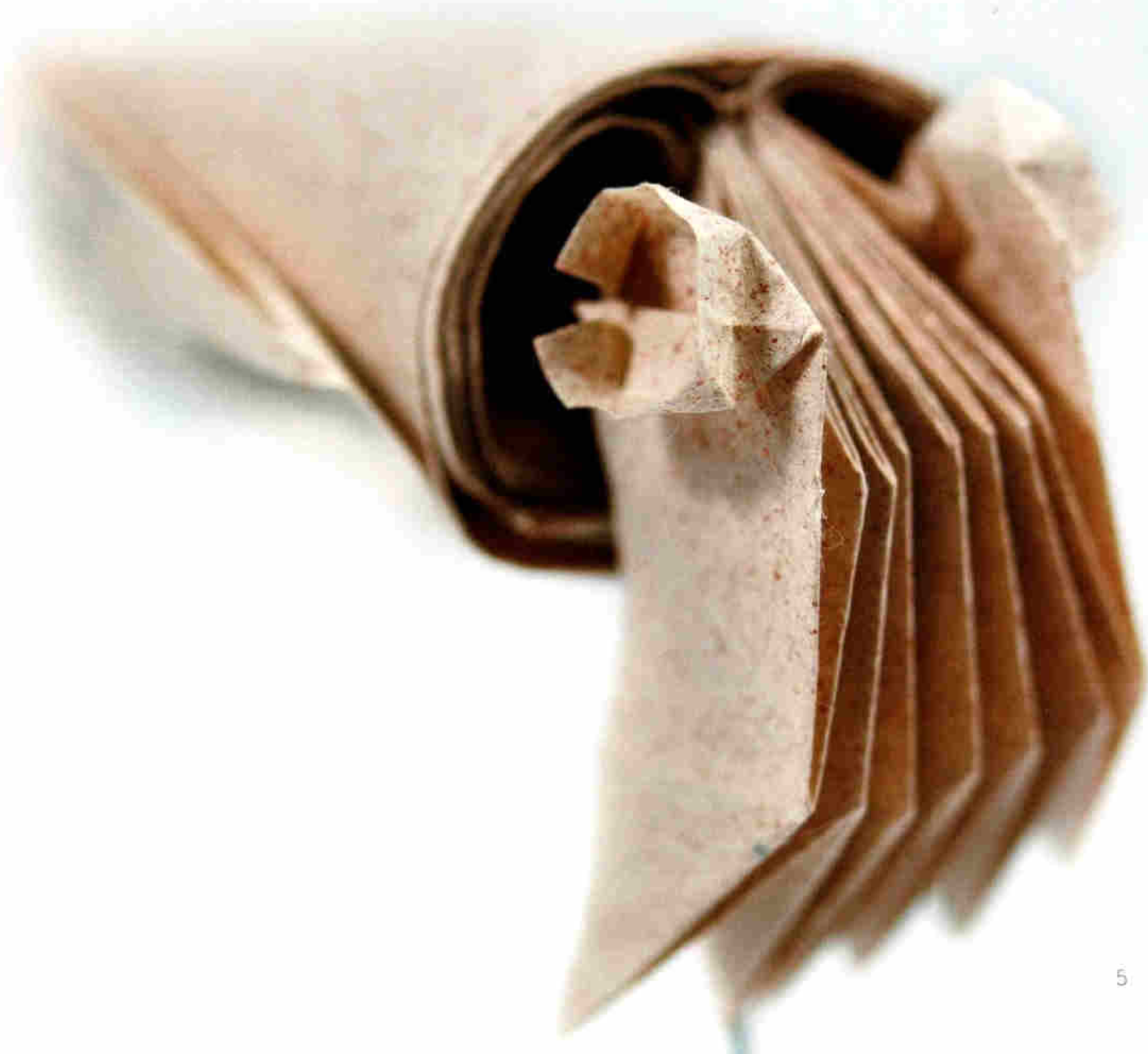
The models in *Marine Origami* were designed and diagrammed in a four year period between 2015 and 2018. There are twenty-six designs, many of which are based on species I have encountered in the ocean. I hope that the models are worthwhile to fold. My goal is to inspire more people to appreciate the art of origami, and to bring attention to the beauty and importance of the natural world that we depend on.

On Figurative Origami

There are various types of origami. In figurative, or representational, origami, the basic idea is simple: fold a square sheet of paper into a recognizable design without any cuts. Each design is based on a set of simple folding patterns, yet these can be combined into incredibly complex structures. From a single sheet of paper comes an infinite range of forms.

Origami is an abstract form of art. Lines, creases, angles and edges represent the subject in an intricate display of geometry. It is the intersection between the mathematical world of the uncut square sheet of paper and the freedom of artistic creativity.

Each piece is the accumulation of hours of complex design and spatial engineering. The challenge is to capture the essence of the subject within the limits of the paper. The true beauty is displayed not only in the finished piece, but in the efficiency of the paper distribution and folding process.





How to Use this Book

This book is intended for folders of intermediate to high skill level. If you are unfamiliar with the diagram symbols, refer to the symbols page near the back of the book.

The diagrams are meant to be a guide. If you have trouble on a step, carefully observe the diagram. Refer to the previous step and the next step, paying attention to every change. Try to visualize the change that took place. If you still can't understand, take a break and try again later. It is important to be patient and treat the diagrams as a puzzle.

Tools & Supplies

TWEEZERS

Use tweezers to aid folding. They are helpful for executing small folds and details.

CREASER

Creasers, also known as bone folders, can take the strain off of hand folding, especially when folding with thick paper. They can also be useful for creasing delicate papers that can be damaged by fingertip creasing.

CUTTING DEVICE

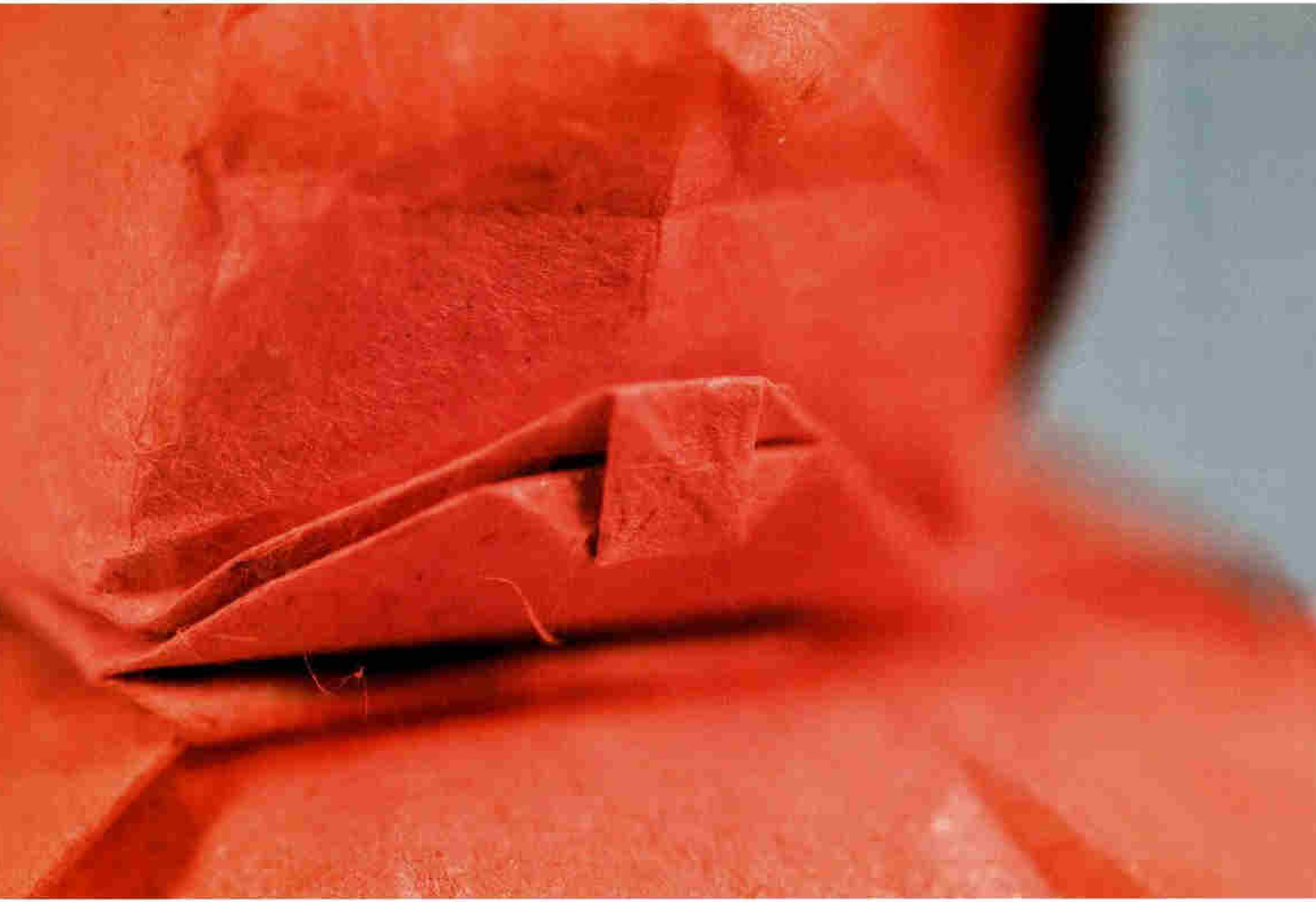
To quickly and reliably cut a square from a rectangle or larger paper, you will need a cutting device. The best option for cutting exact squares is a rotary cutter with a cutting mat and ruler. Otherwise use letter cutters or scissors.

GLUE

Although glue is not required to fold the models in this book, I highly recommend using it to make shaping permanent. I prefer using super glue for shaping, but other types of glue such as methylcellulose work as well. If you use super glue, make sure you work quickly and avoid applying the glue against any surface layers where it can stain through.

NOTE: These are the basic tools and supplies to fold the models. You may need to add supporting wires or make bases using other materials and tools.





Paper Choice

To create beautiful pieces, you will need great paper. After all, the folded origami is just a sheet of paper. There is no one perfect type of paper for a model. When selecting paper, take into account thickness, crispness, size, color, texture and other factors. Some suggestions are thicker paper for simpler models; solid-colored, plain paper for models with sharp, well-defined faces; and fibrous paper for highly shaped models. If you are folding larger models, choose thicker paper that will support the models' structures. If you are folding smaller models, choose thin, but strong paper. Choosing the right paper for each model is essential if you want to present the design to the best it can be.

Before you fold the final model, practice folding with standard origami paper to avoid making mistakes on the good paper. You can try folding the same model with different types of paper. Note that for the majority of models, it is better to fold with larger paper as it makes the finished work more visible; in smaller models, the details tend to be overlooked.

Cephalopods

Squid

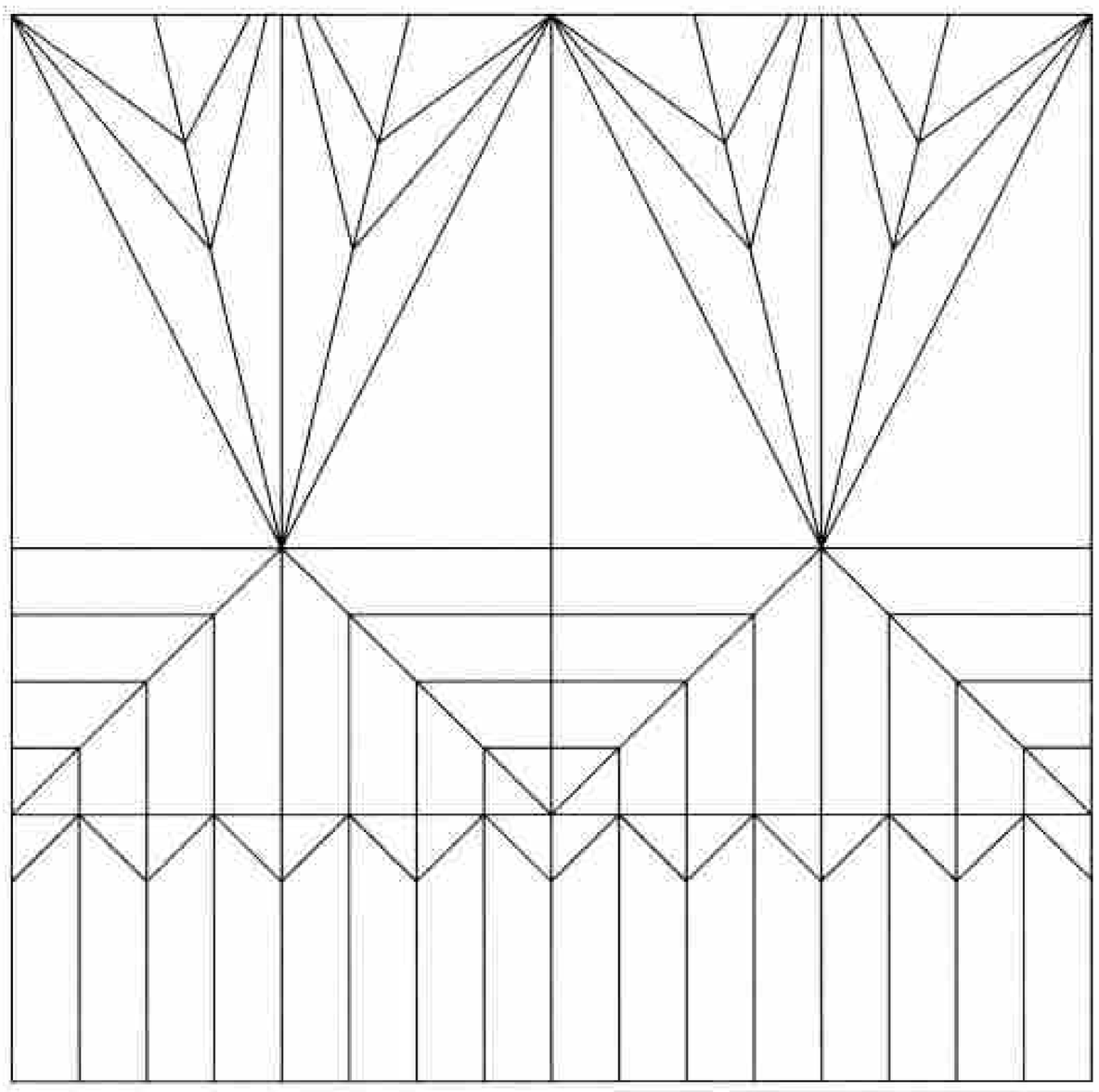
Cuttlefish

Octopus

Dumbo Octopus

Squid

The squid is the first model I designed in the marine origami series. The model is generalized into three parts: the body, fins, and tentacles. The cone-shaped body of the squid is secured with a lock, and the unused paper in the cone folds out to create fins. The tentacles are left in a simple pleated form.





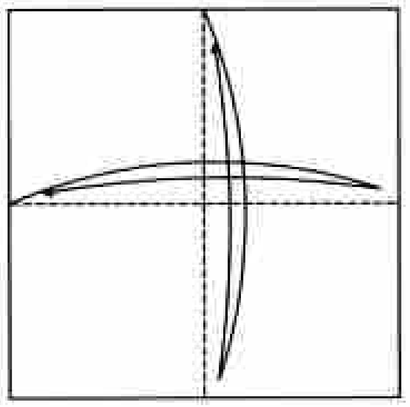
5
Fold and unfold through all layers. Unfold everything.

7
Collapse on existing creases.

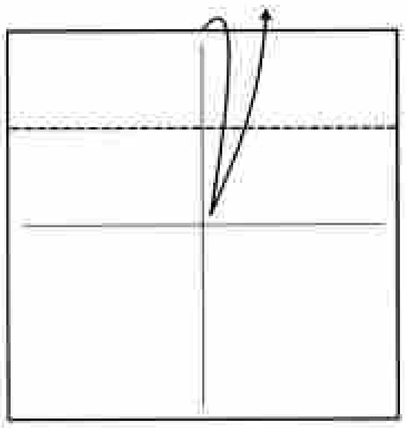
8
In progress.

11
Repeat steps 10 to 11 behind.

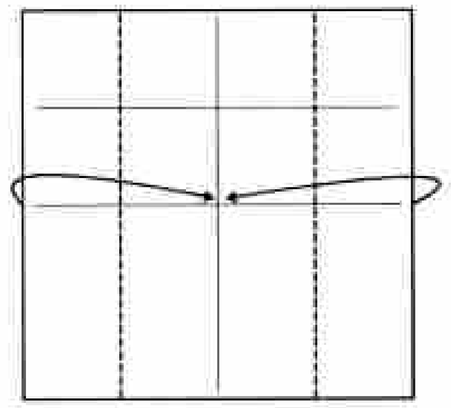
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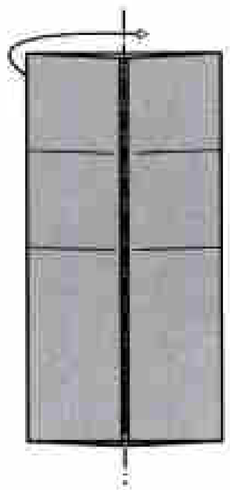
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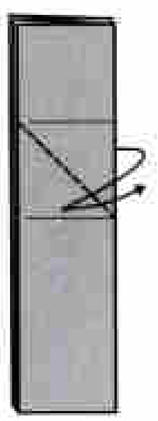
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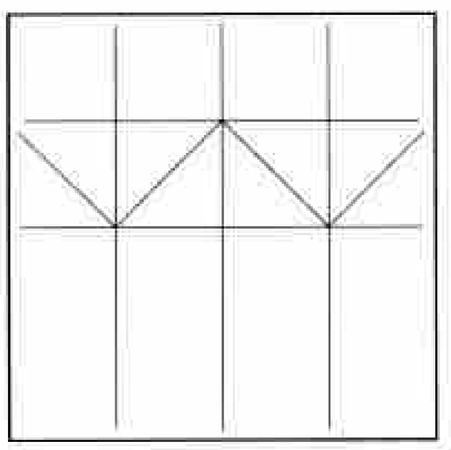
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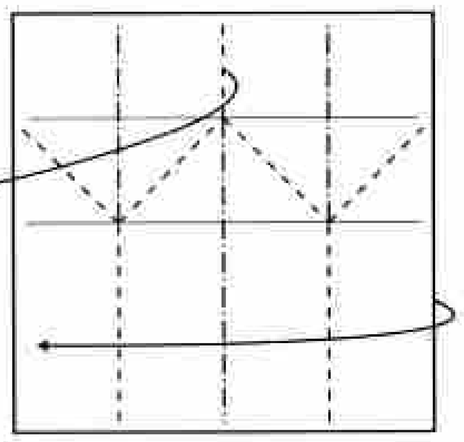
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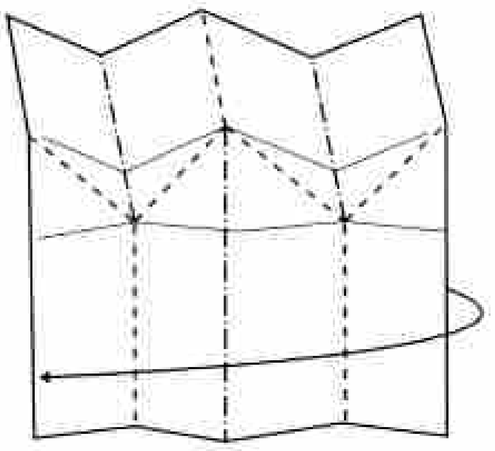
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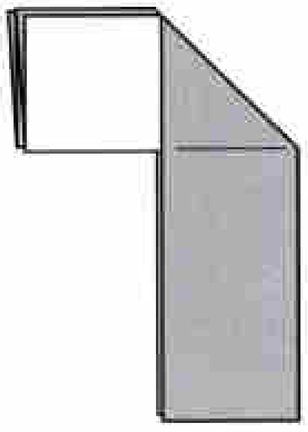
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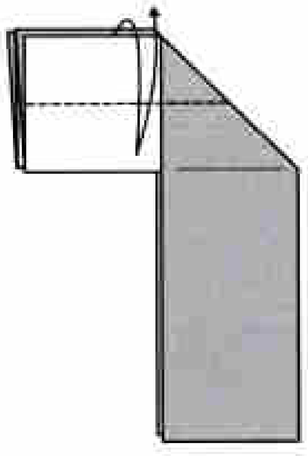
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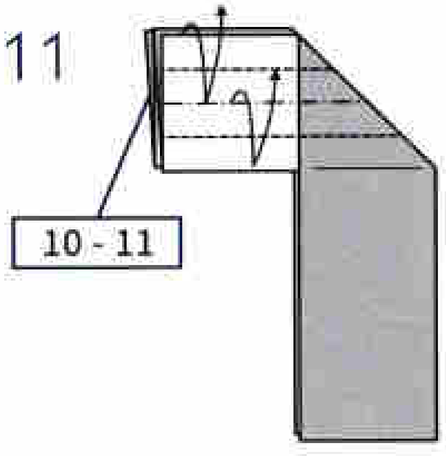
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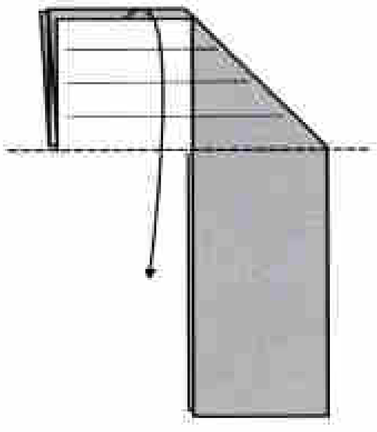
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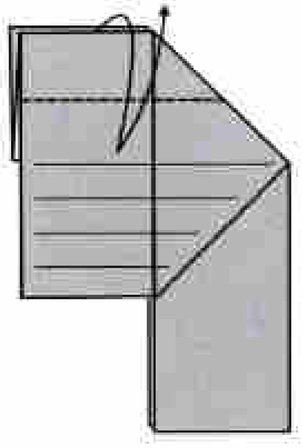
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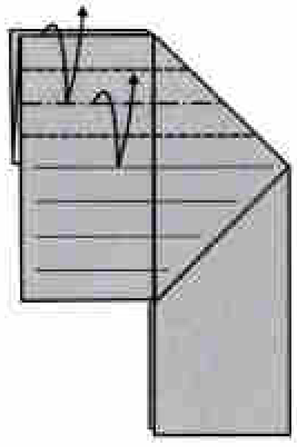
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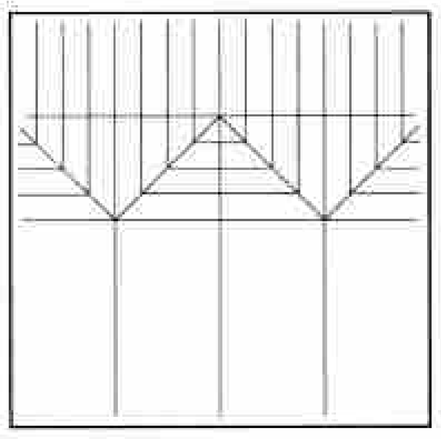
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14



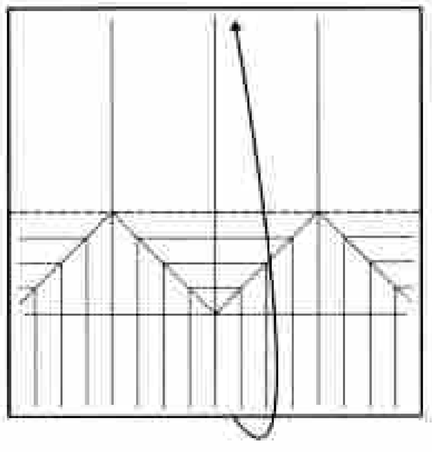
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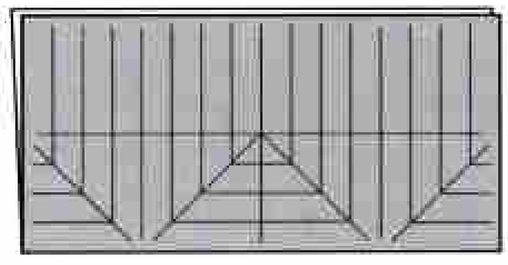
14
Fold and unfold.
Unfold every-
thing.

15
Rotate.

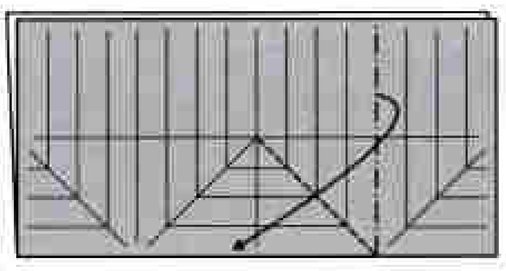
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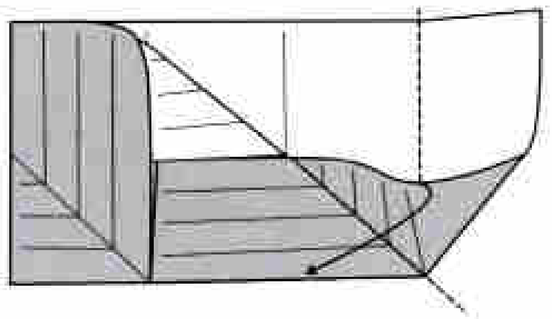
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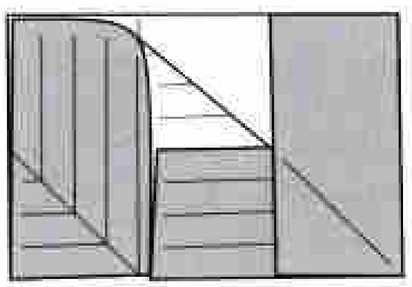
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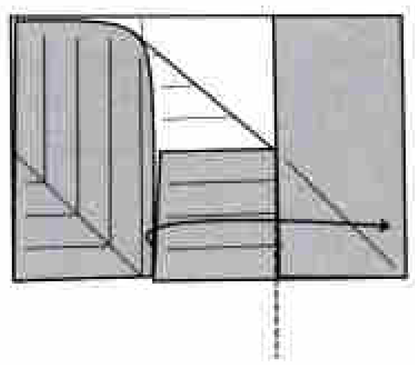
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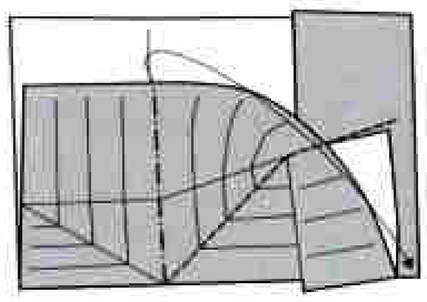
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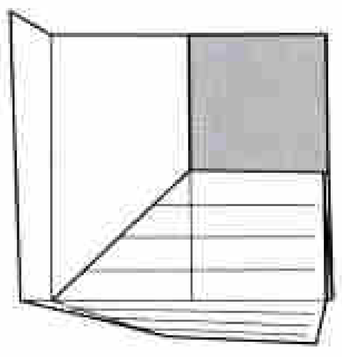
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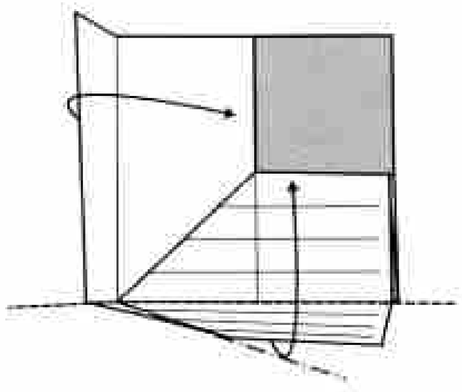
22



23



24



25
Unfold the model. Bottom view.

27
Pleat on existing creases.

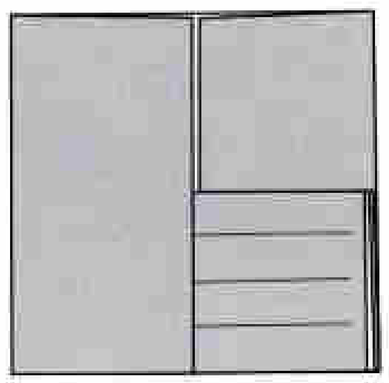
28
Pleat completed.

30
Unfold the model. Bottom view.

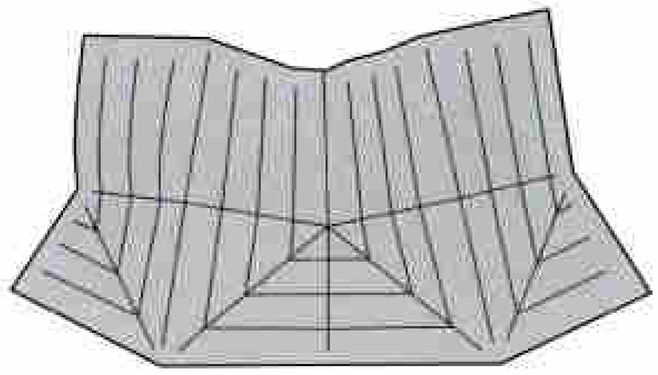
31
Pleat on existing creases. Reverse on zig-zag.

32
In progress.

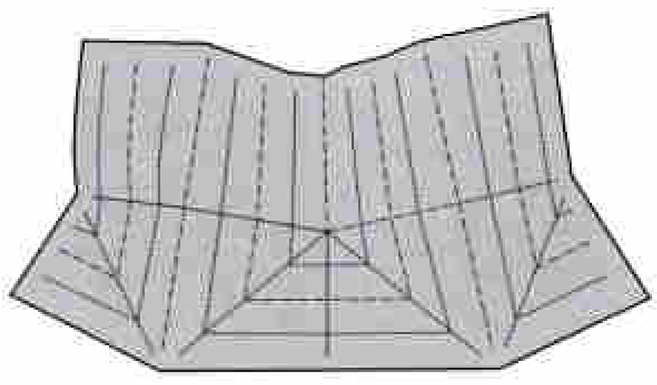
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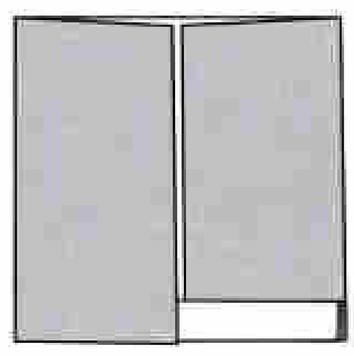
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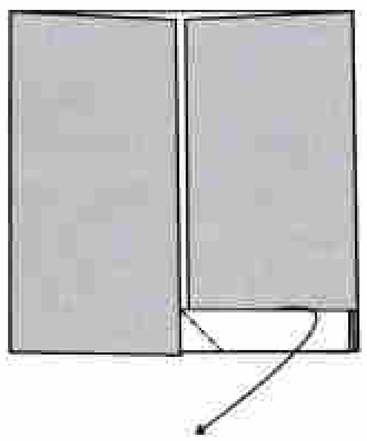
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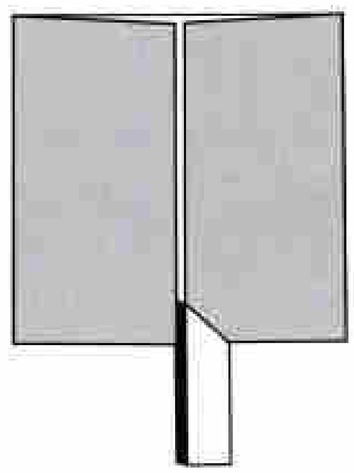
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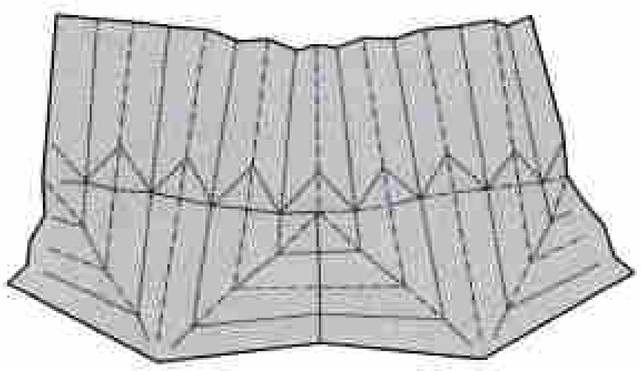
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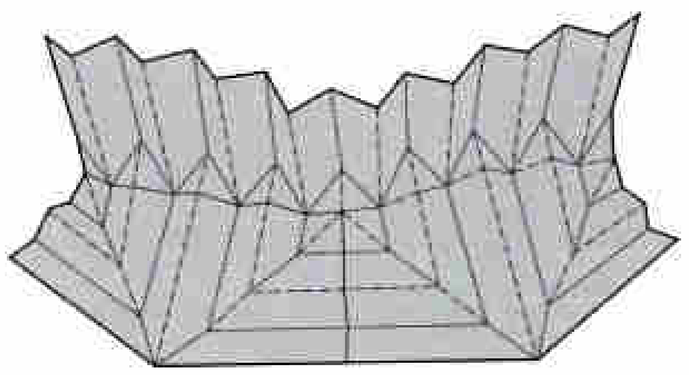
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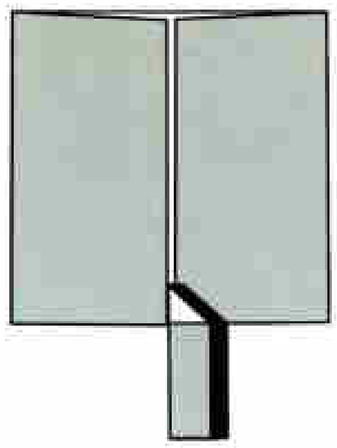
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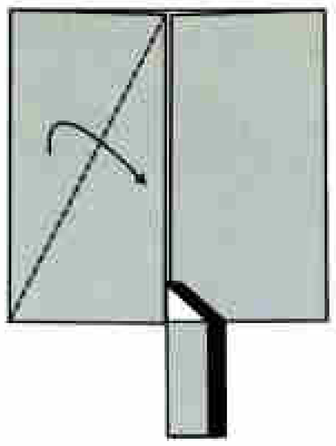
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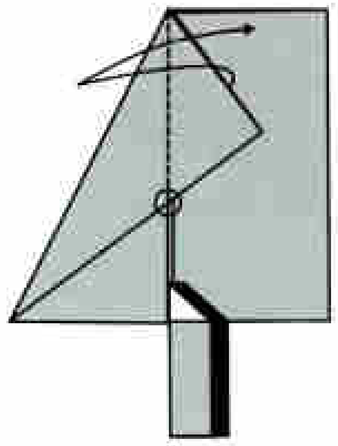
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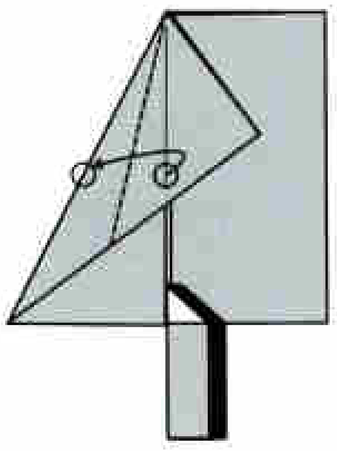
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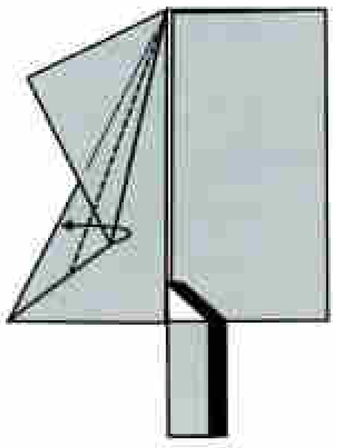
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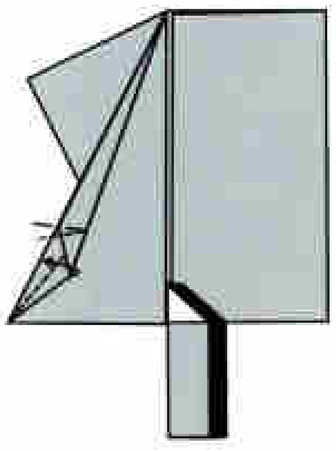
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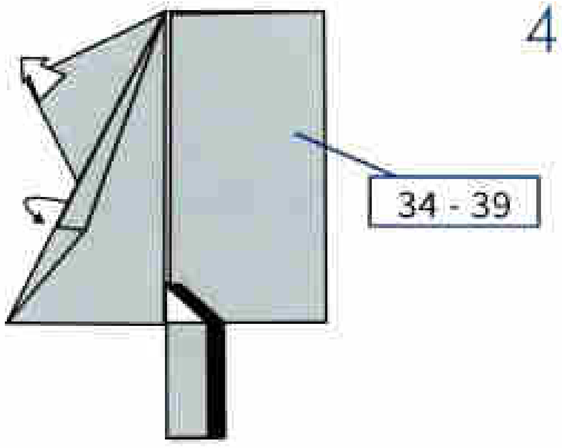
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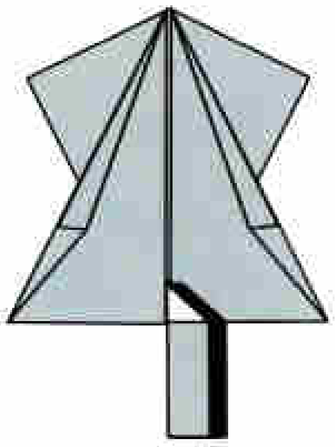
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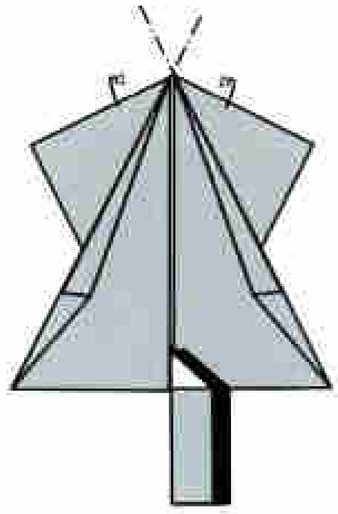
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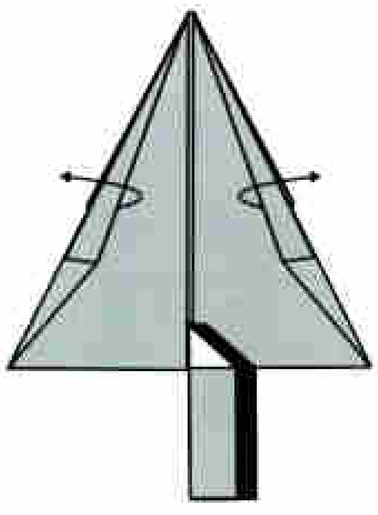
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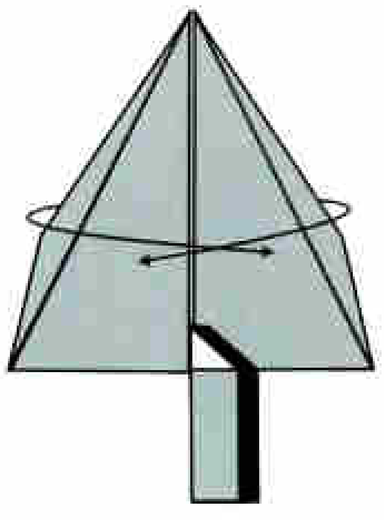
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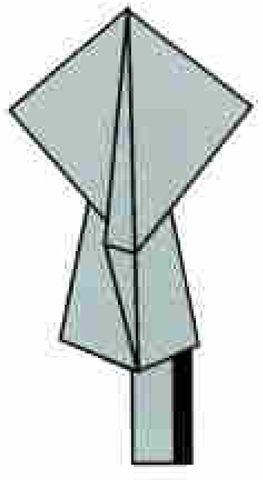
42



43



44



33
Pleat completed.

36
Angle bisector.

37
Angle bisector.

38
Rabbit ear fold.

39
Pull out fin and wrap around rabbit ear fold to lock. Repeat steps 34-39 on the right side.

43
Form into a cone.

44
Right flap should overlap the left flap.

45

Insert right flap into the pocket behind. Model is not fully locked.

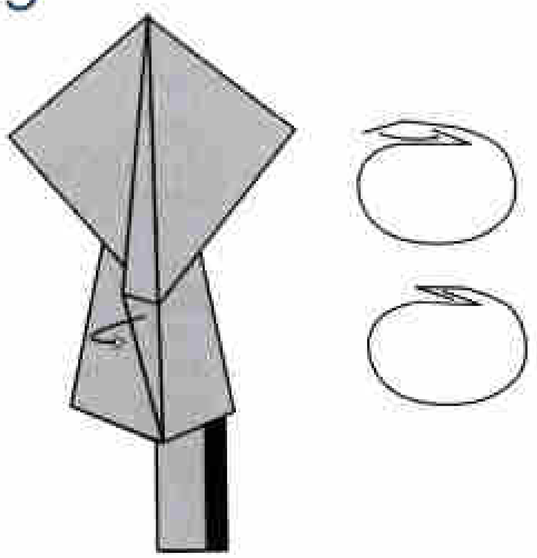
47

Mountain fold to complete lock.

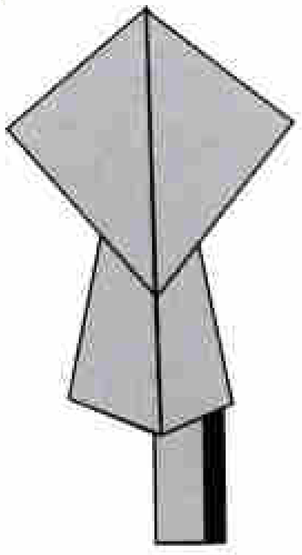
49

Squid completed.

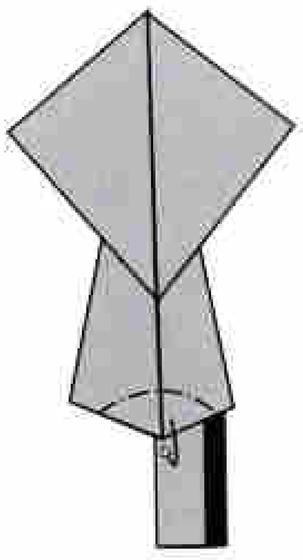
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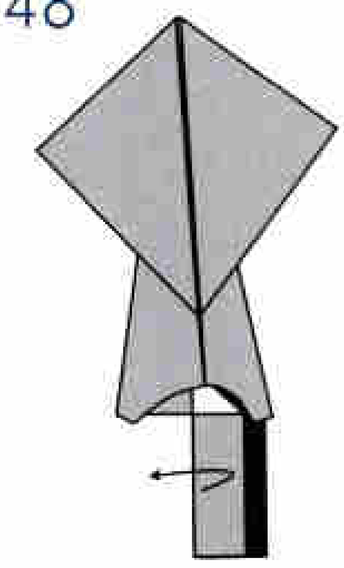
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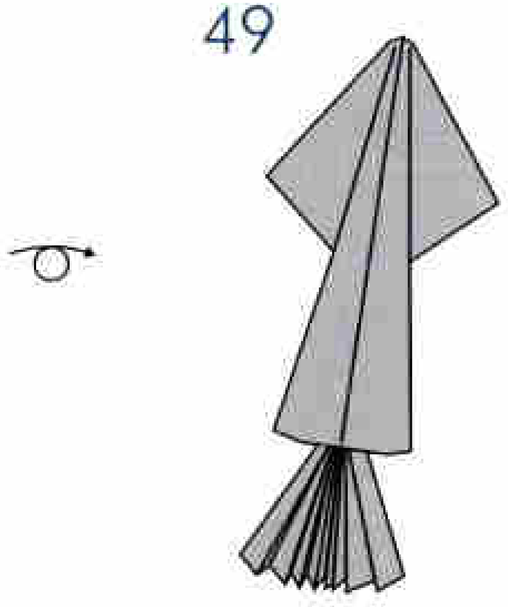
47



48



49



On Creating Origami

Before you begin designing a model, visualize how you want to present the work. Is the piece minimalistic or complex? Should a work be composed of multiple folded models? Does it need to be supported by a base or a stand?

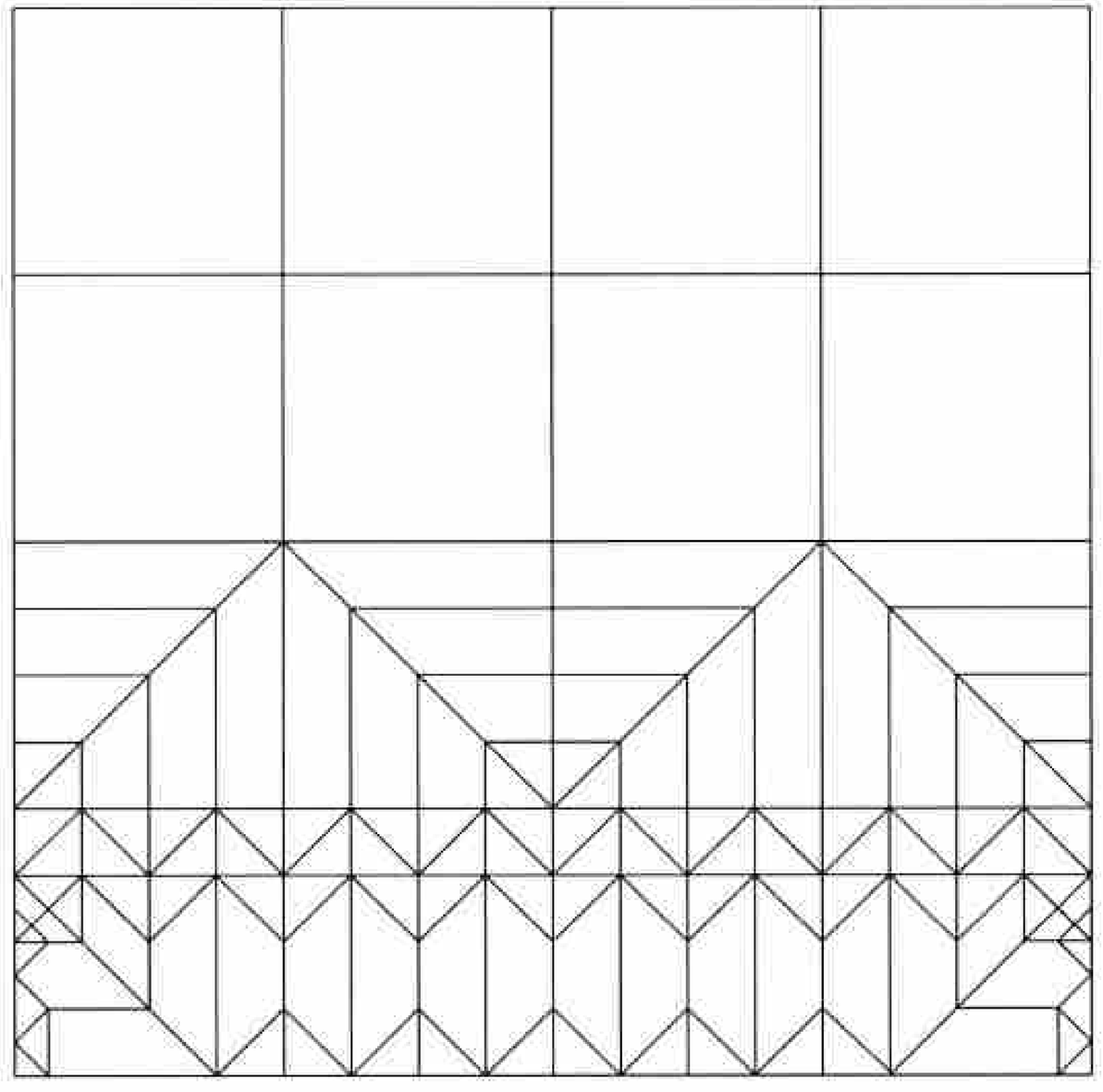
The first step in creating origami is to choose paper. The paper should reflect the style or theme of the model. For example, the squid is a minimalist model; it is best folded with solid-colored, thick paper that will compliment the model's simplicity. The second step is to fold the model. Folding begins with careful precreasing, followed by collapsing and shaping. Here, the folder adds shaping details and chooses a pose if the model requires it. The final step is the presentation of the folded piece. This could include adding a supporting base, reinforcing the model with internal wires, and adding glue to make the shaping permanent. Consider: what type of base should the piece be displayed on? What materials complement the look of the paper? Each piece can be displayed in a number of ways.





Cuttlefish

This model is derived from a modification of the squid base. The body locks with a folding sequence similar to wrapping a gift box, the pleats are twice reversed so that the tentacles point down, and the extra flaps around the body are folded out to create the side fins. The cuttlefish is one of my favorite models in the series; all the parts come together in a way that seems so satisfying to fold.



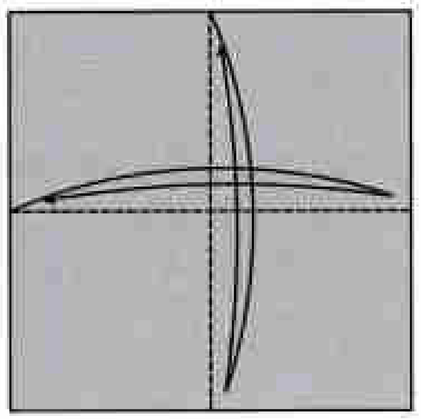


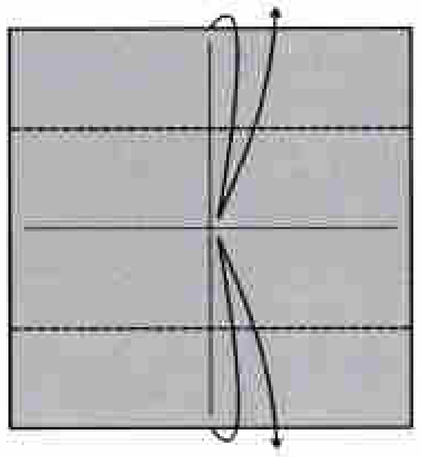
5
Fold and unfold through all layers. Unfold everything.

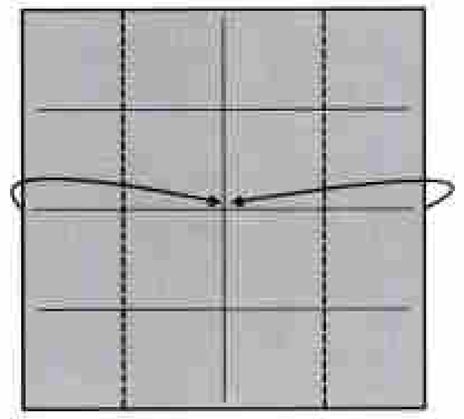
7
Collapse on existing creases.

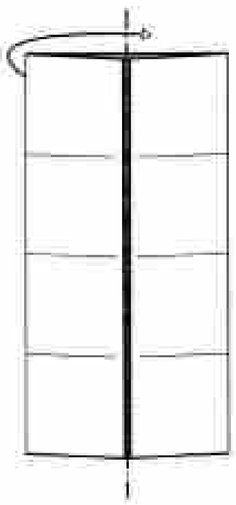
8
In progress.

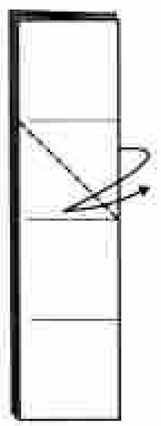
11
Repeat steps 10 to 11 behind.

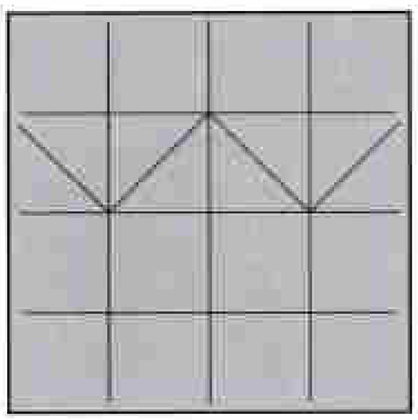
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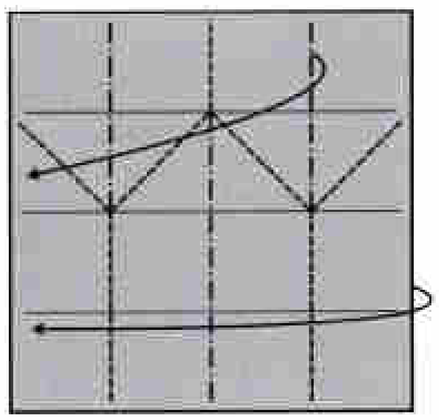
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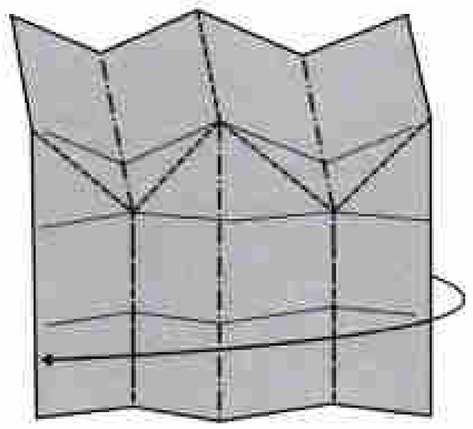
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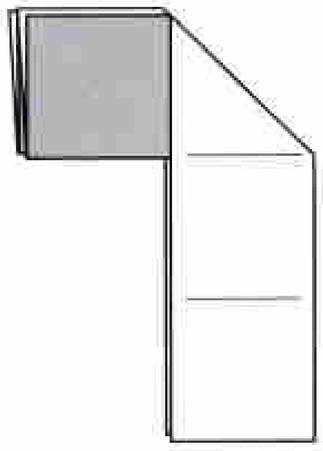
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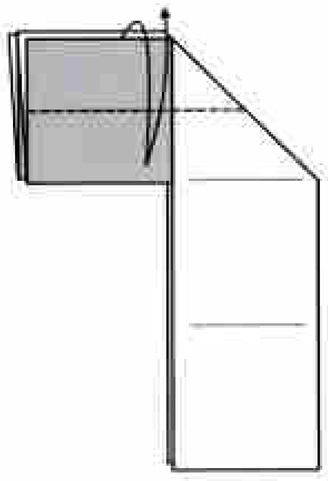
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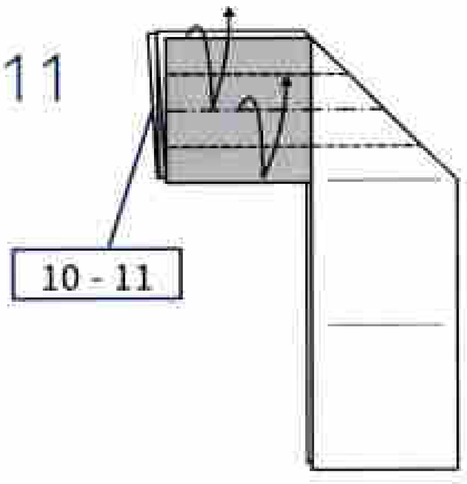
6


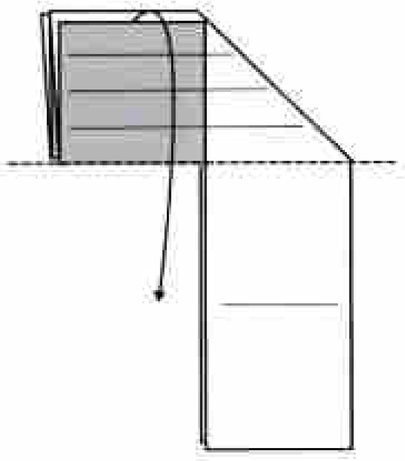
7


8


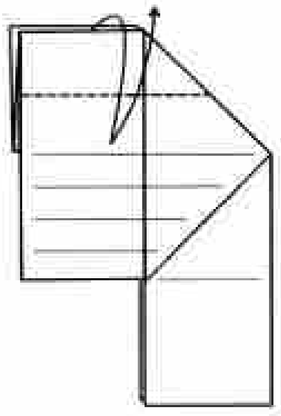
9


10


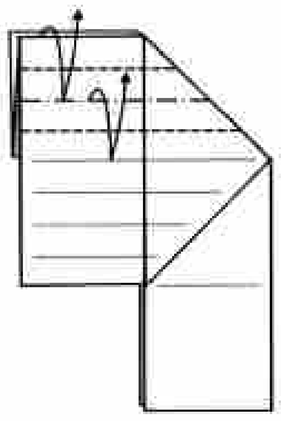
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12


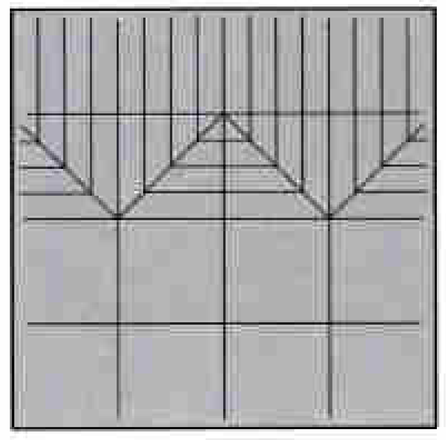
13



14



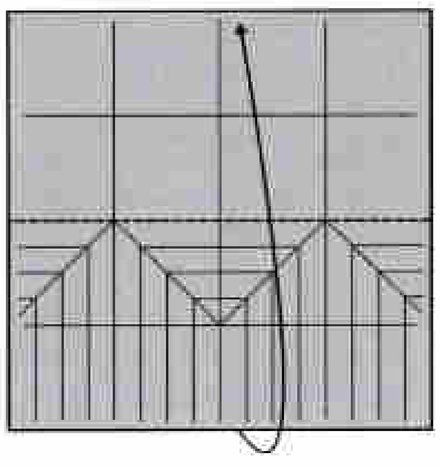
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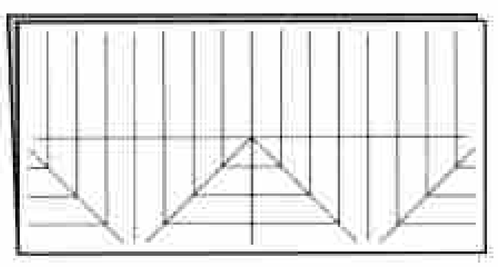
14
Fold and unfold.
Unfold every-
thing.

15
Rotate.

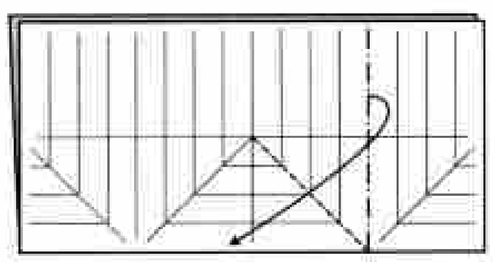
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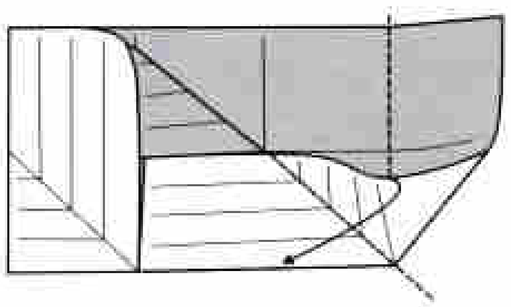
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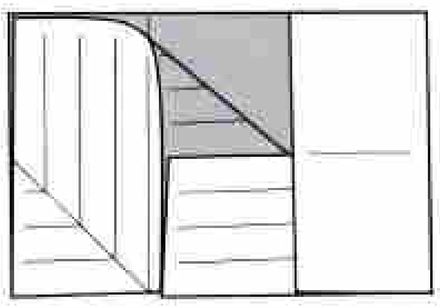
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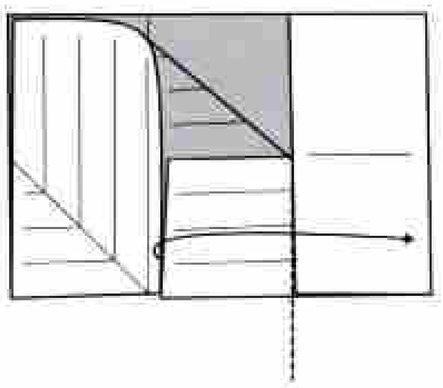
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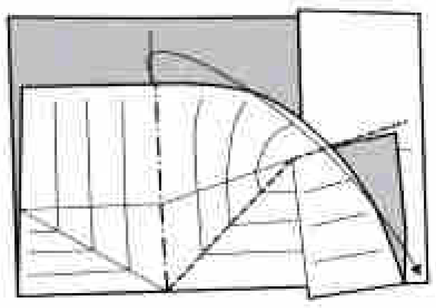
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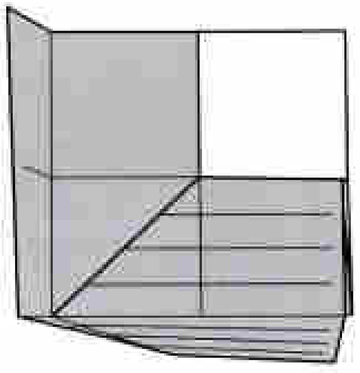
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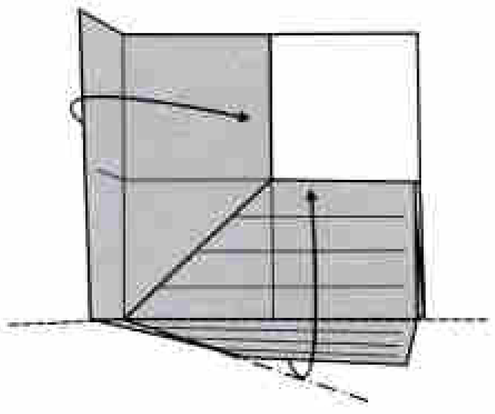
22



23



24



25
Unfold the model. Bottom view.

27
Pleat on existing creases.

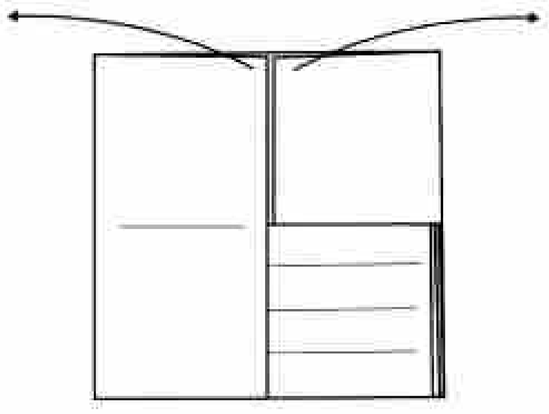
28
Pleat completed.

30
Unfold the model. Bottom view.

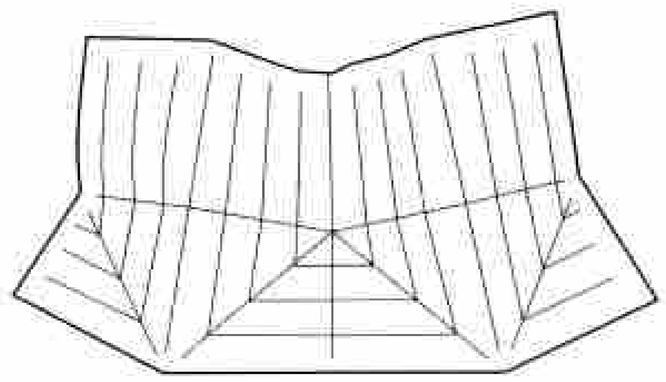
31
Pleat on existing creases. Reverse on zig-zag.

32
In progress.

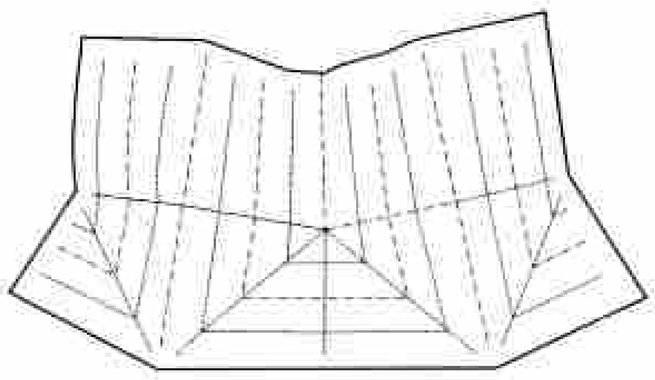
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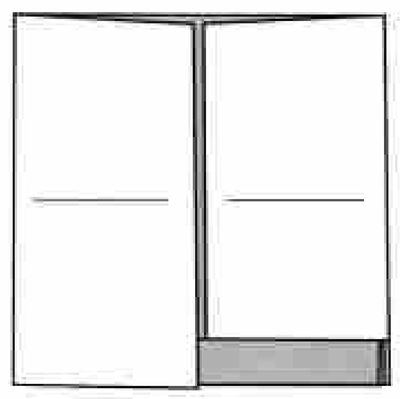
26



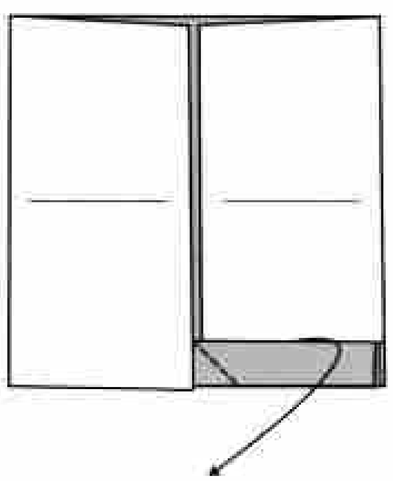
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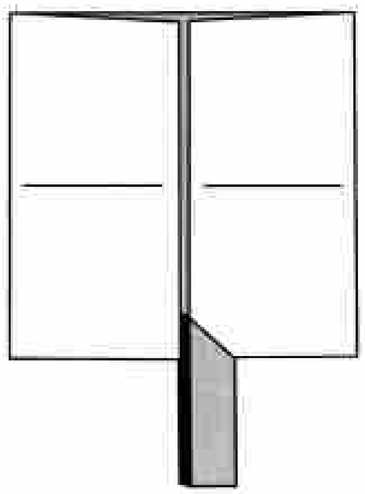
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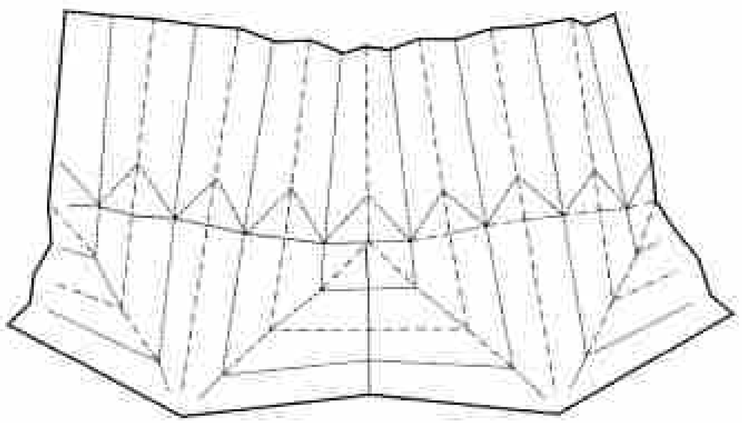
29



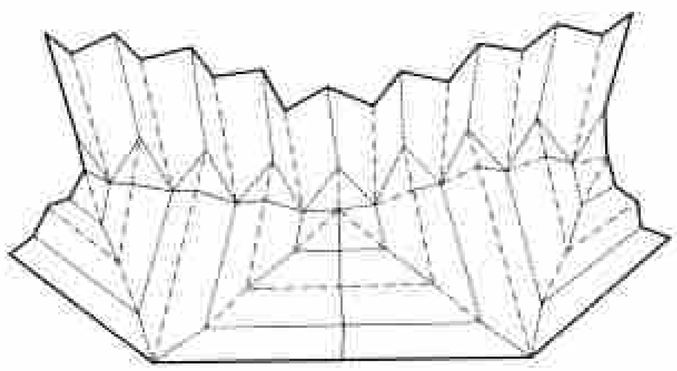
30



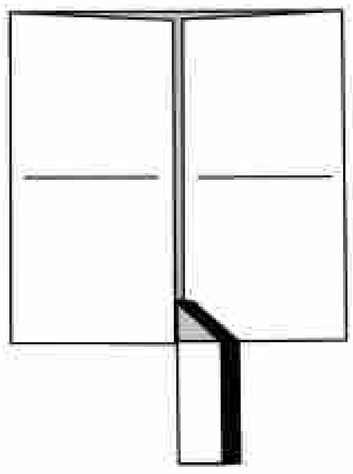
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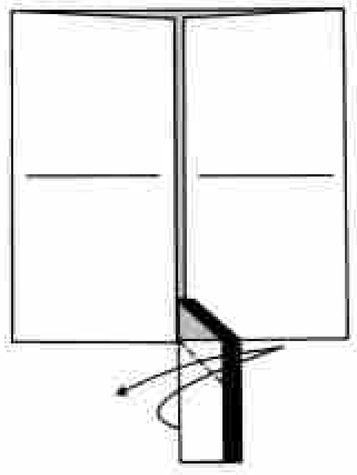
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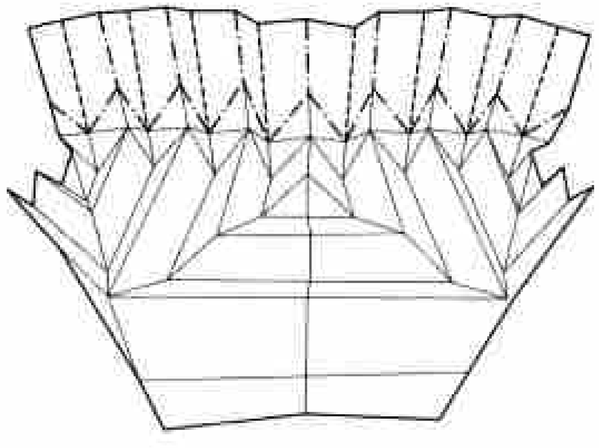
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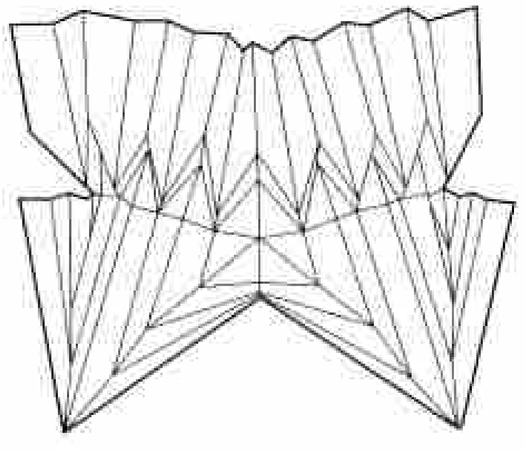
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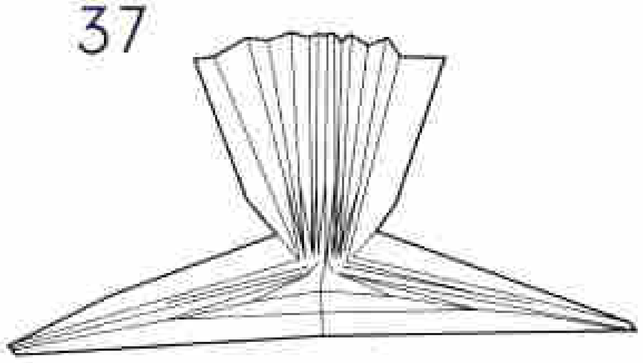
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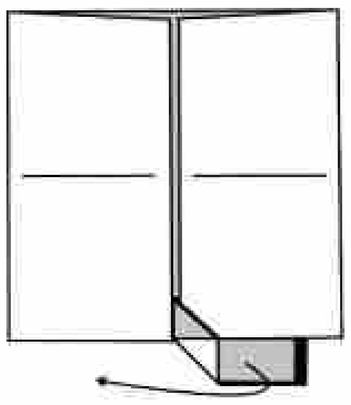
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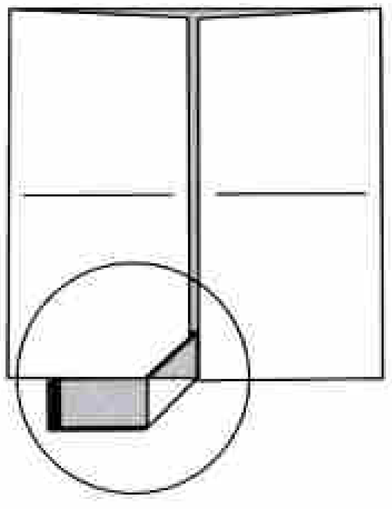
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38

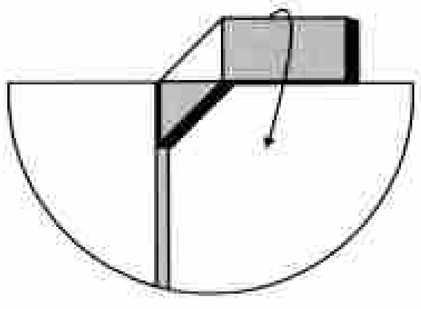


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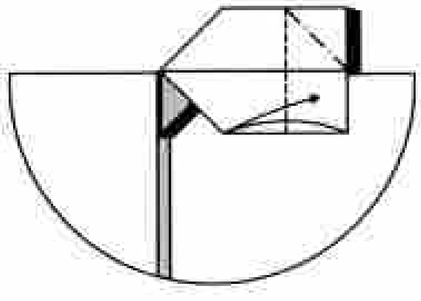


180°

40



41



33
Pleat completed.

34
Fold and unfold. Unfold the model. Bottom view.

35
Pleat along existing creases. Reverse on zig-zag.

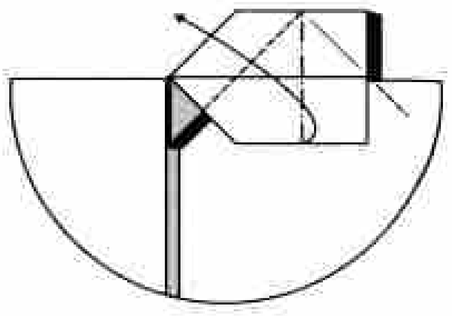
43
Inside reverse fold.

46
Repeat steps 40 to 45 behind.

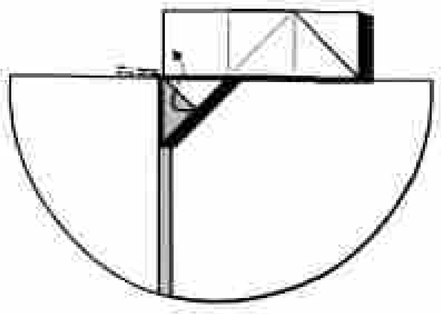
47
Inside reverse folds.

51
Form into a cylinder.

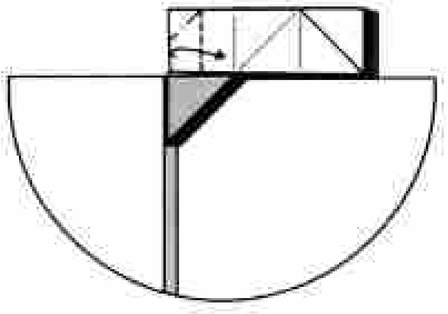
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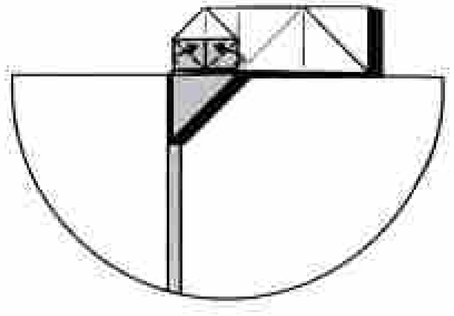
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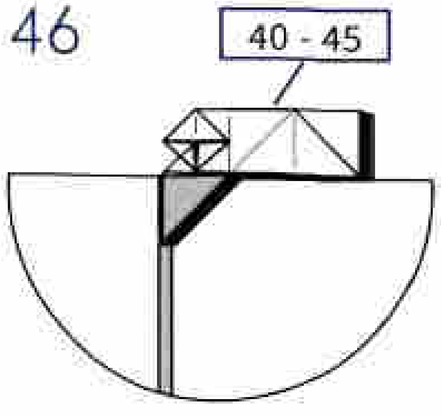
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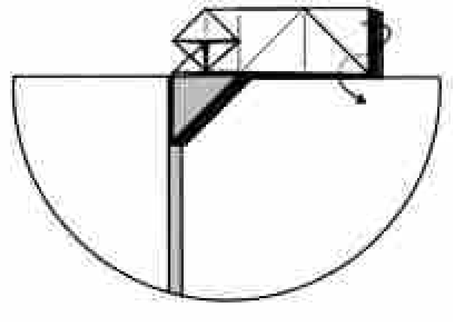
45



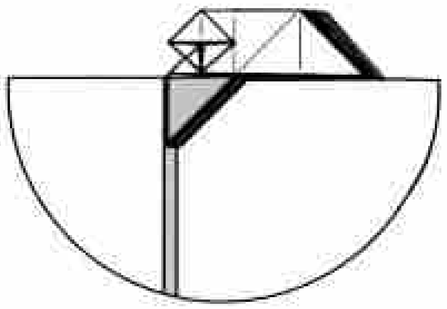
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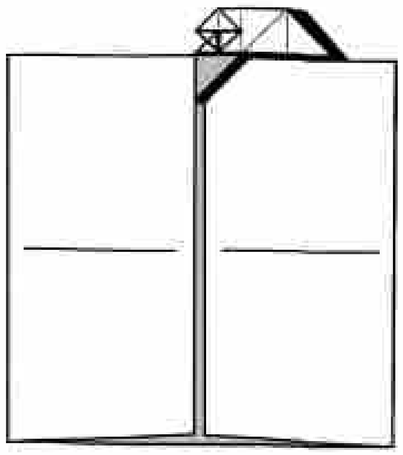
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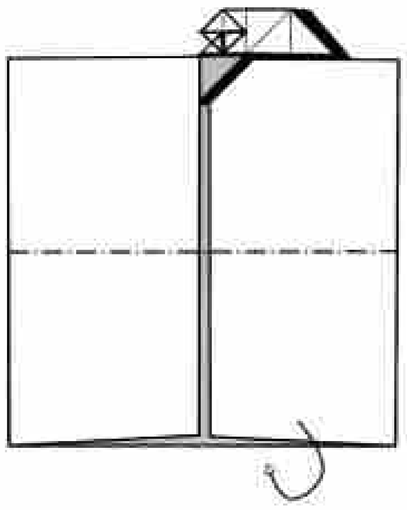
48



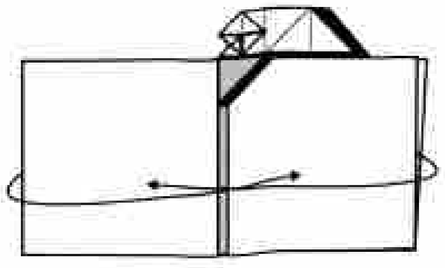
49



50



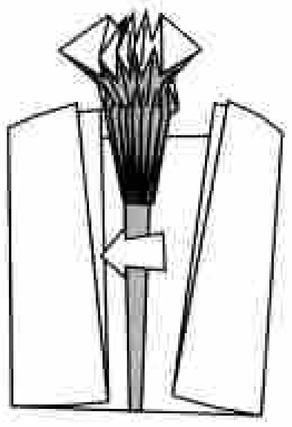
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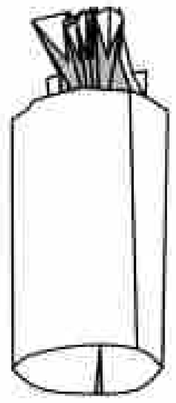
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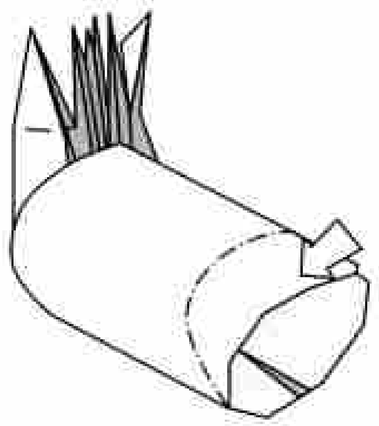
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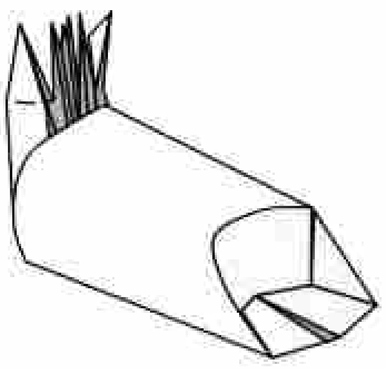
54



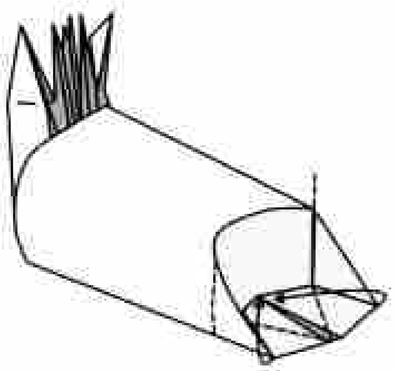
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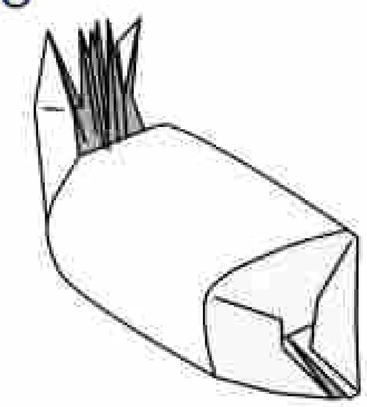
56



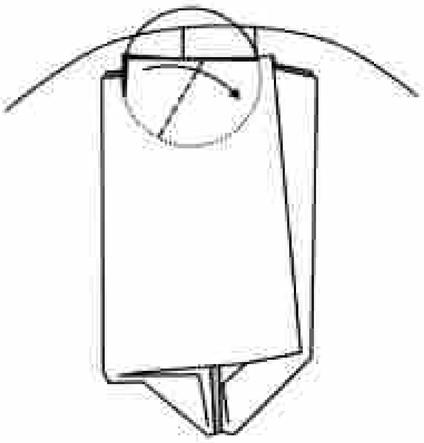
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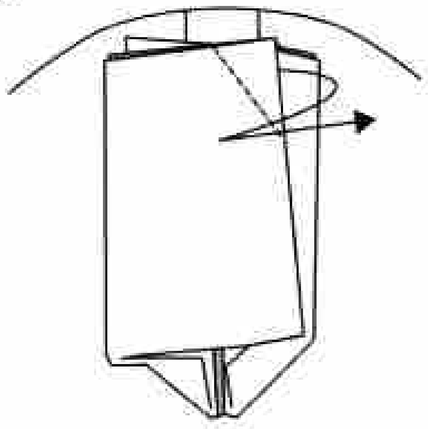
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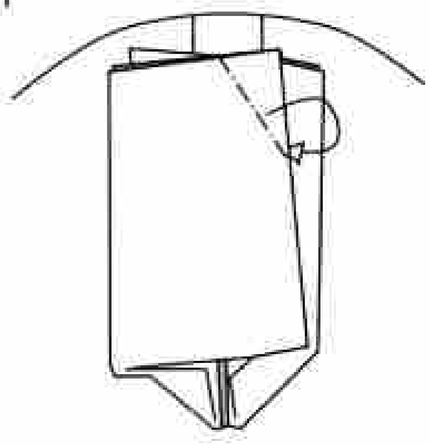
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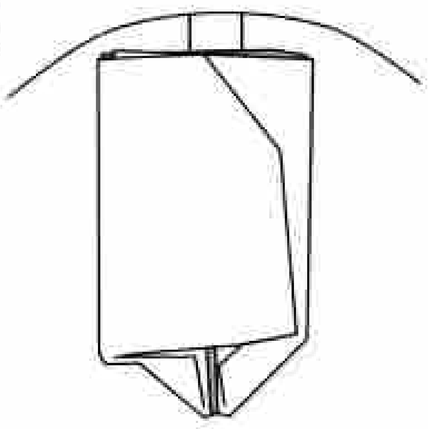
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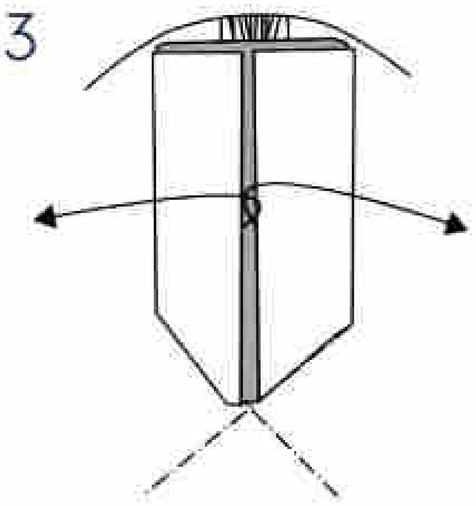
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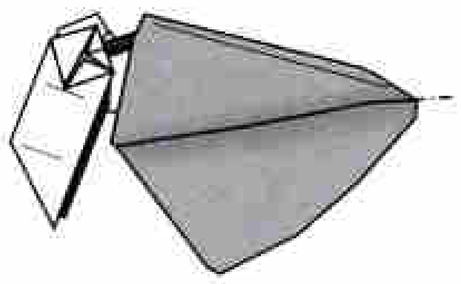
62



63



64



53
Insert right flap into left pocket.

55
Close like wrapping a gift box.

59
Valley fold inner flap 60°.

60
Fold and unfold 60°.

61
Insert flap behind.

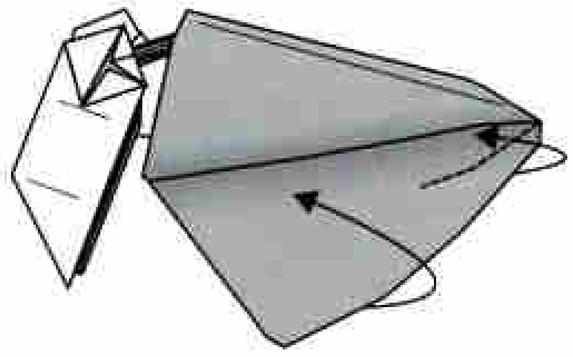
63
Unwrap outer flaps past edge.

65
Angle bisector.

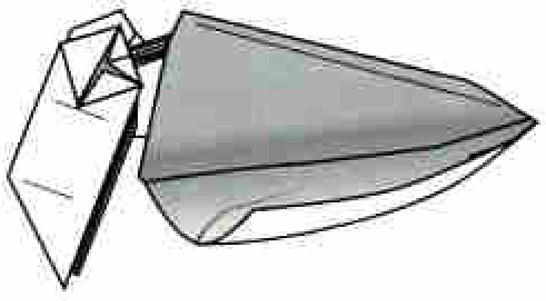
72
Shape eyes.

74
Cuttlefish
completed.

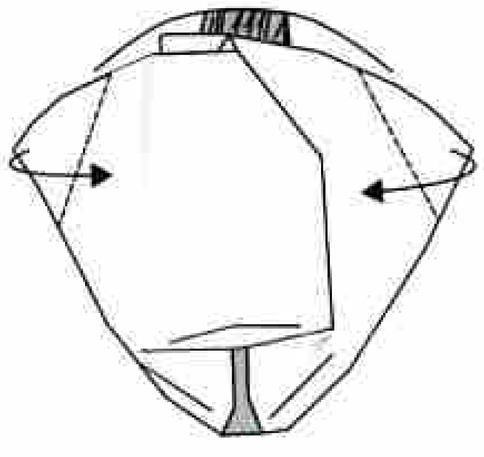
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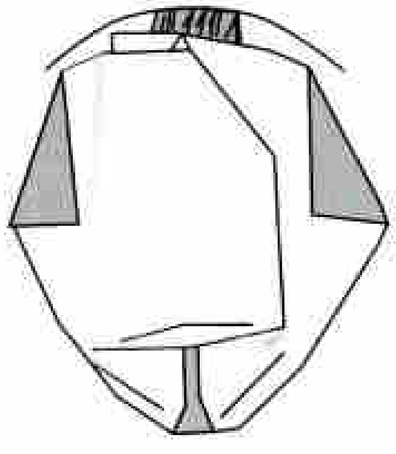
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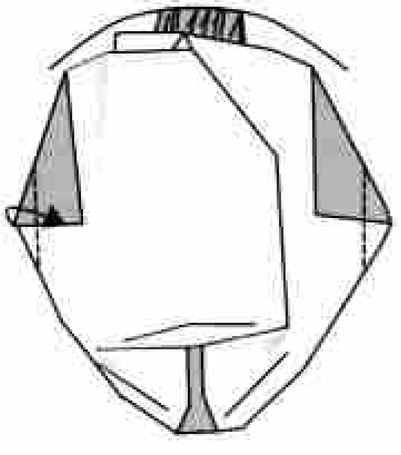
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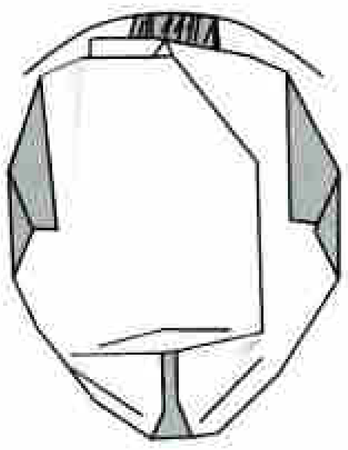
68



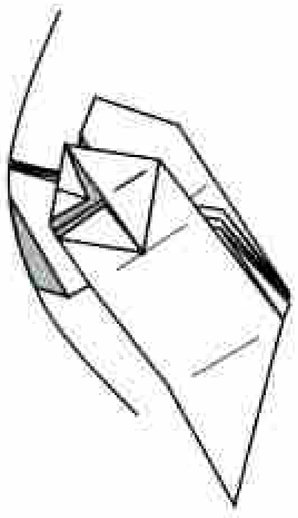
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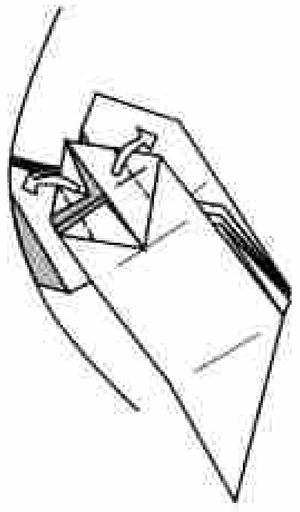
70



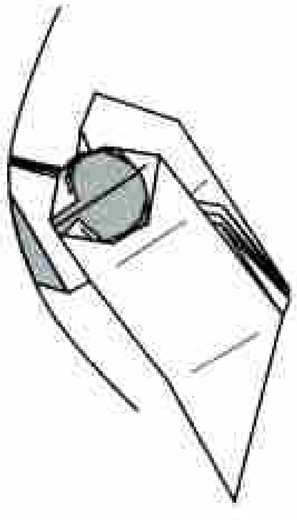
71



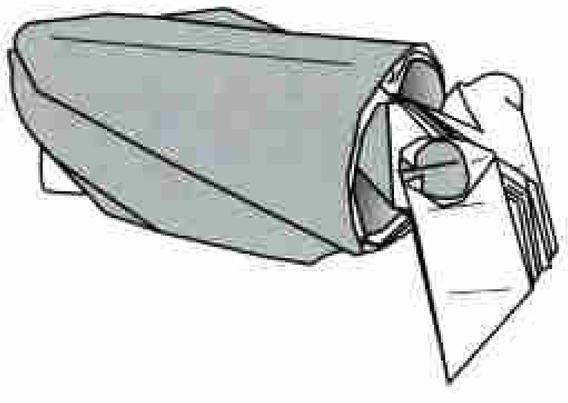
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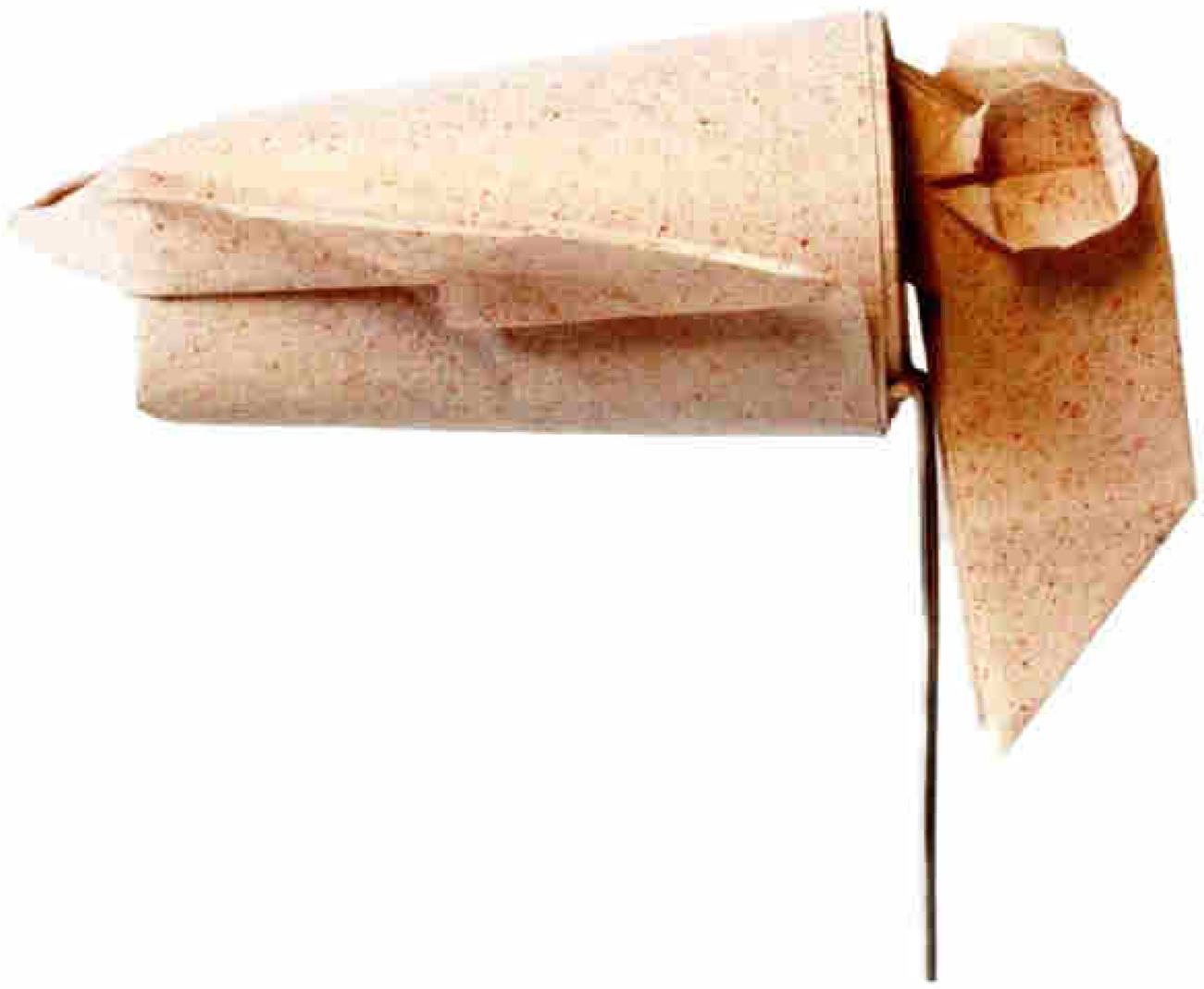


73



74

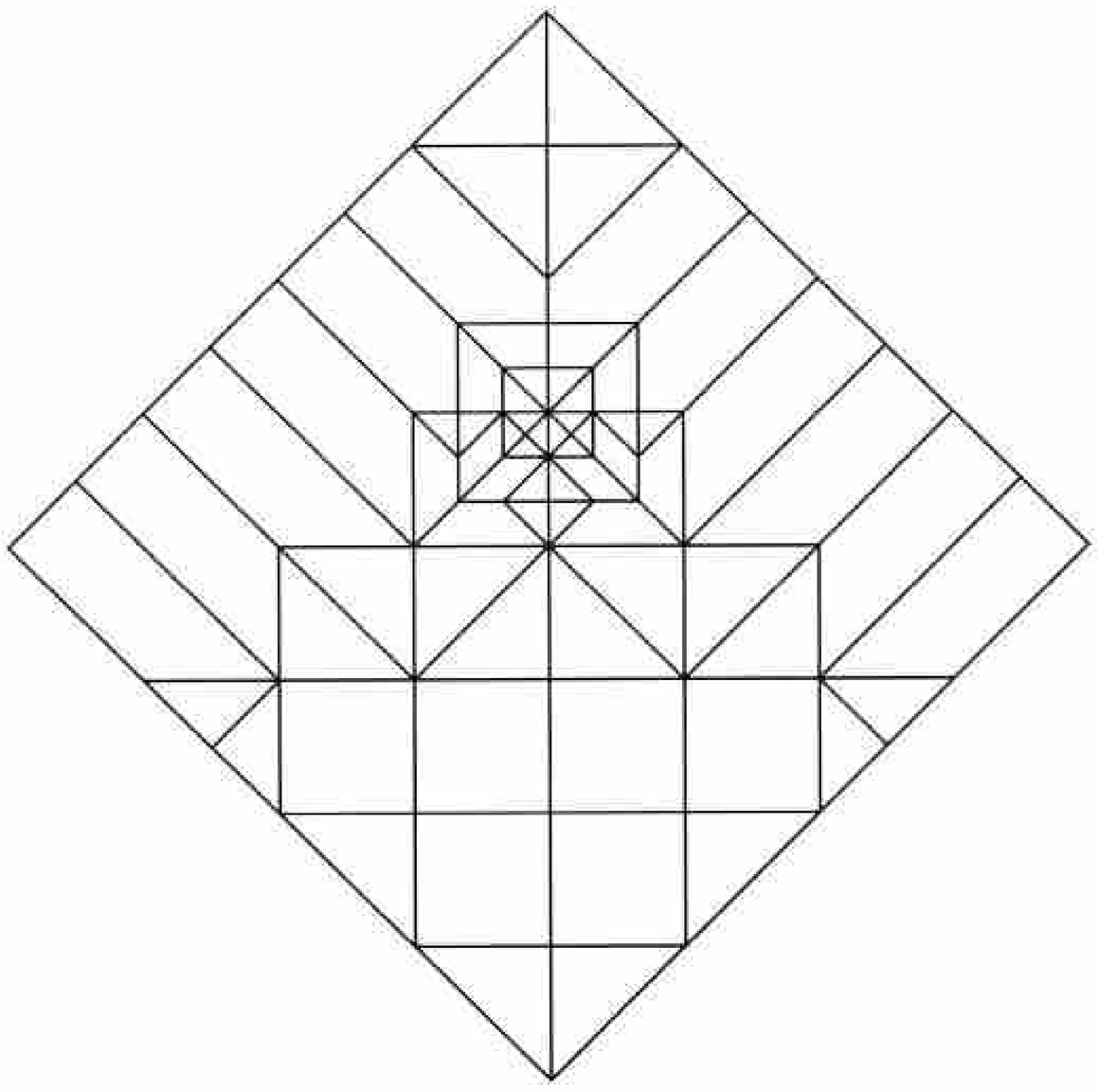




Octopus

The octopus utilizes a box-wrapping sequence similar to that of the cuttlefish. In contrast to the previous two designs, the octopus' symmetry is rotated onto the diagonal axis in order to produce enough paper for the eight tentacles. Each tentacle is supported by an internal wire, enabling them to retain their curls. An initial design added unnecessary folds to the tentacles, and upon realizing this in a later fold, I redesigned the layers.

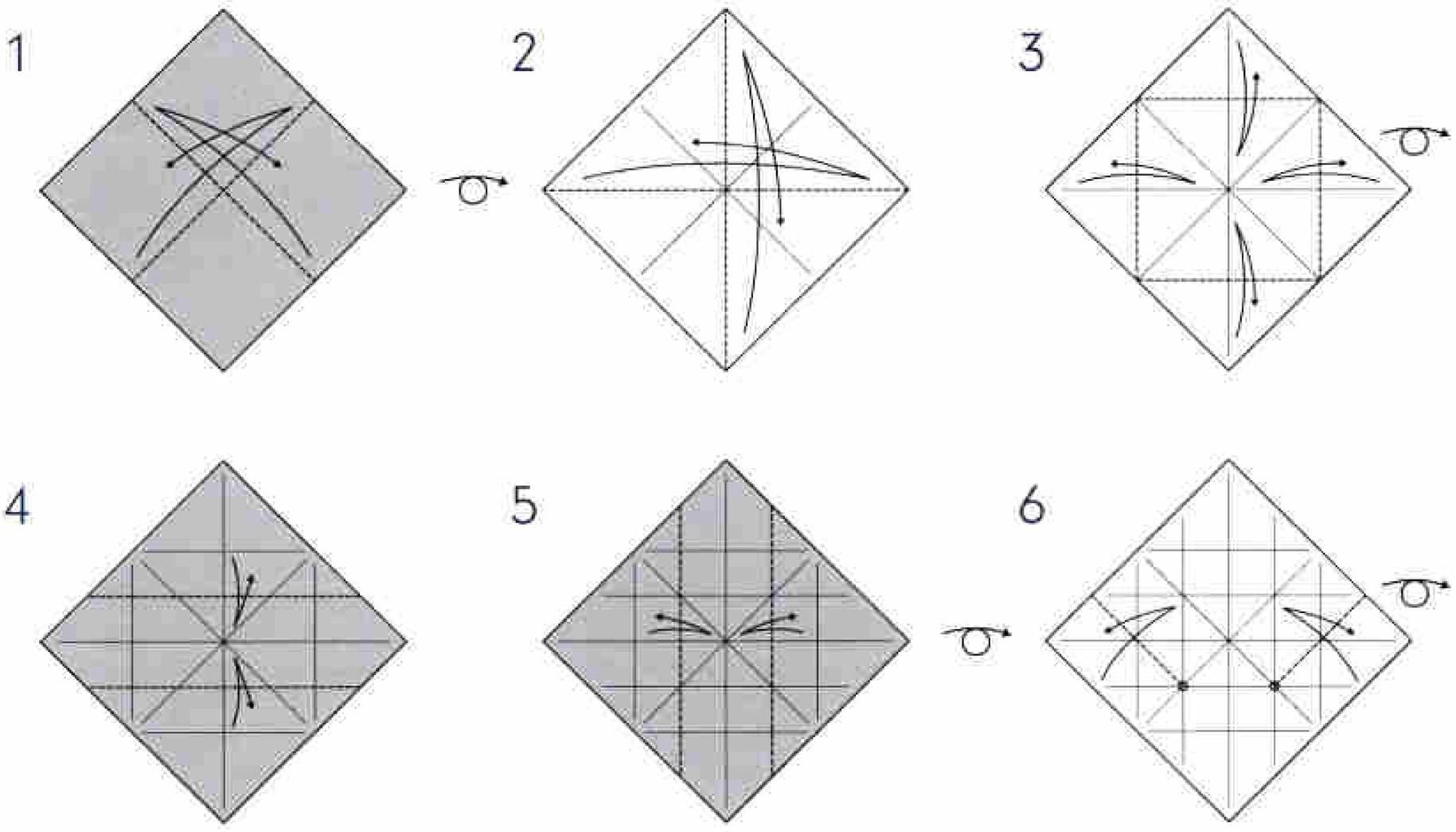
I remember one of the experiences that got me interested in marine biology was the first time I found an octopus; one of its tentacles was protruding from underneath a rock.



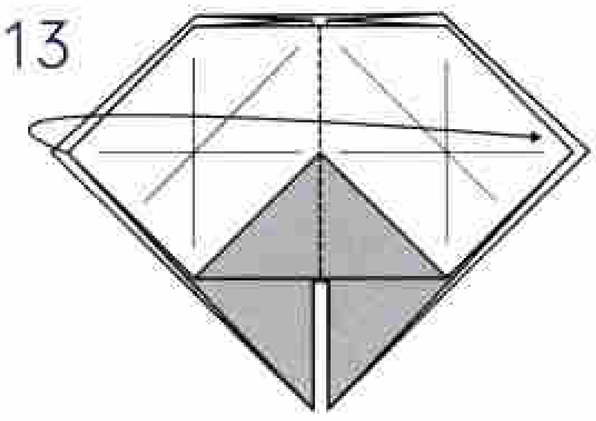


12

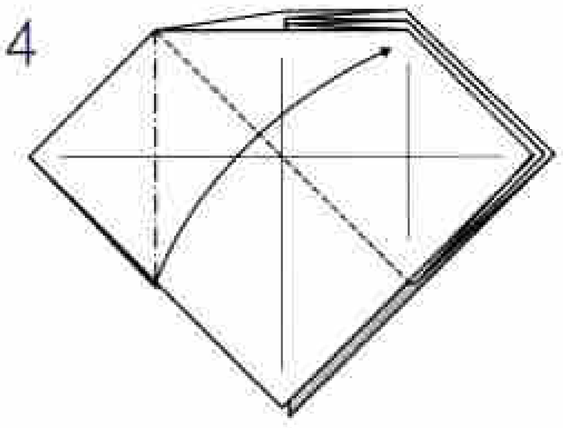
Open sink.



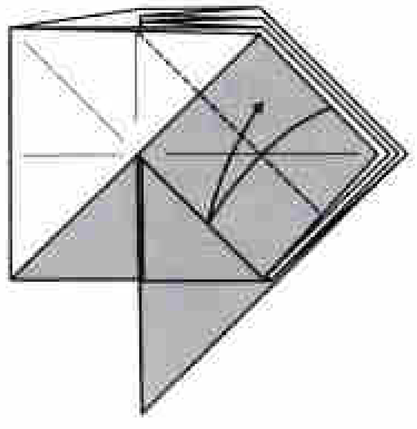
13



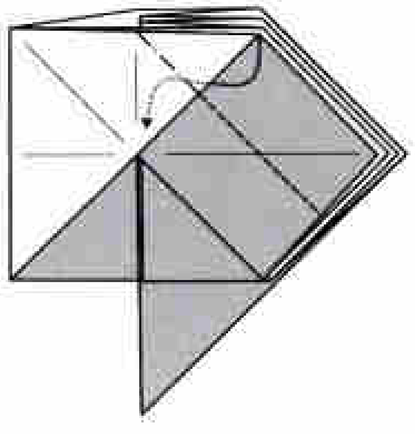
14



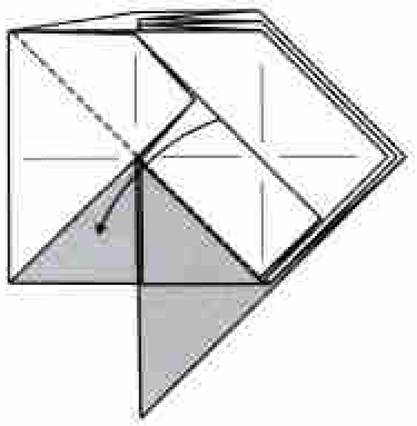
15



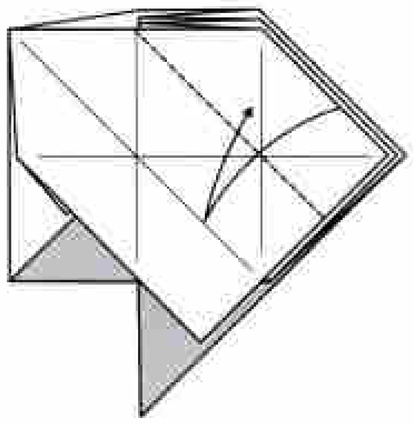
16



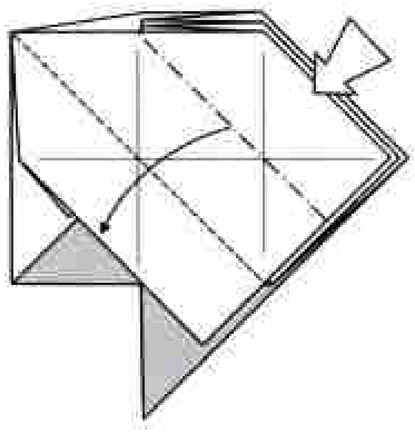
17



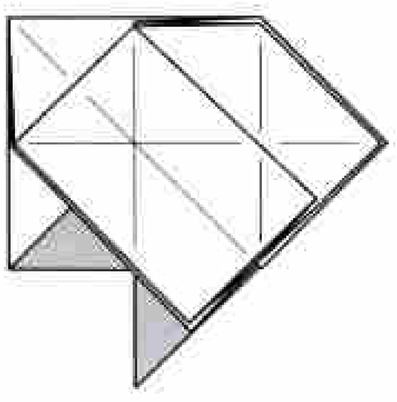
18



19



20



14
Squash.

16
Inside reverse fold.

19
Squash.

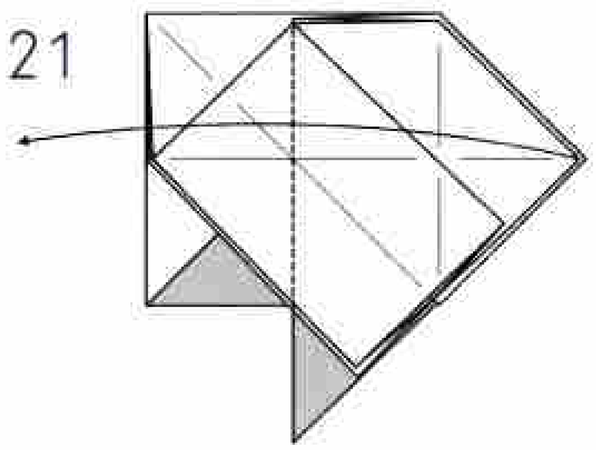
22
Repeat steps 14 to 20.

25
Pleat into thirds and unfold.

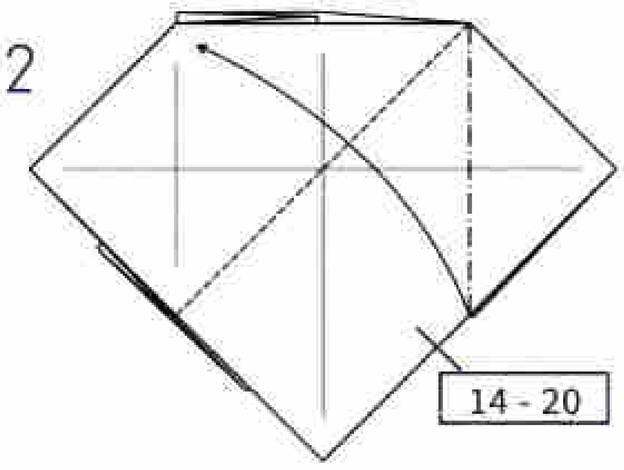
26
Open sink.

27
Reverse the flap.

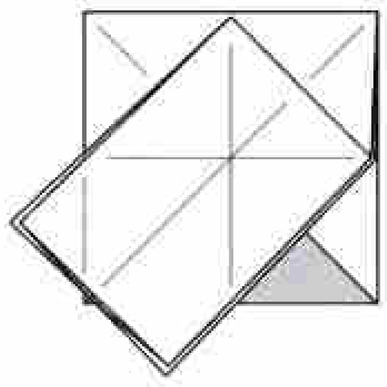
21



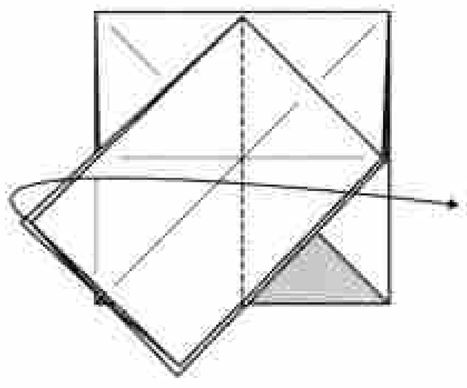
22



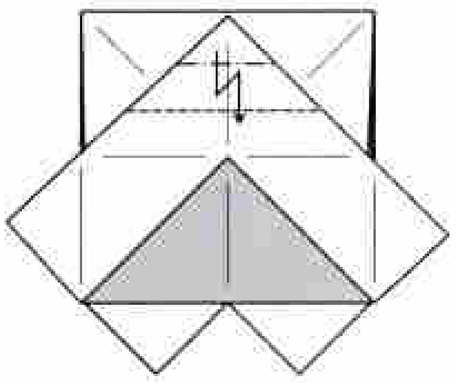
23



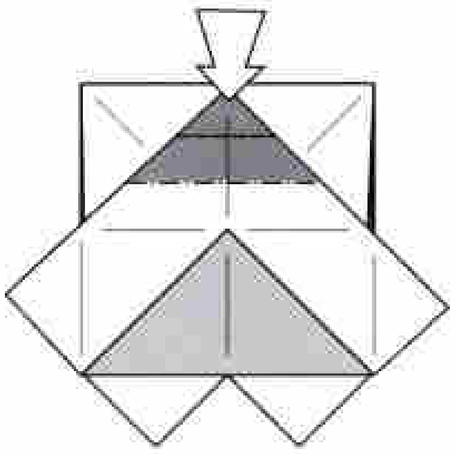
24



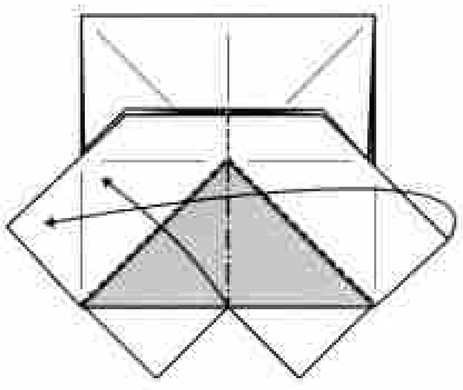
25



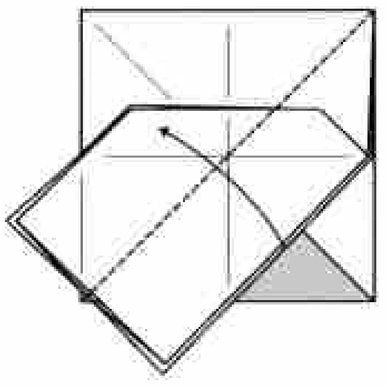
26



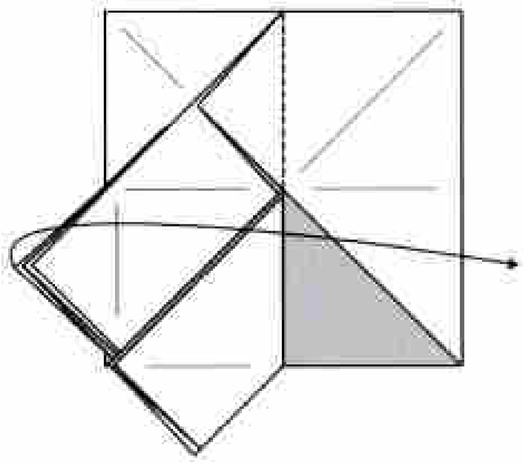
27



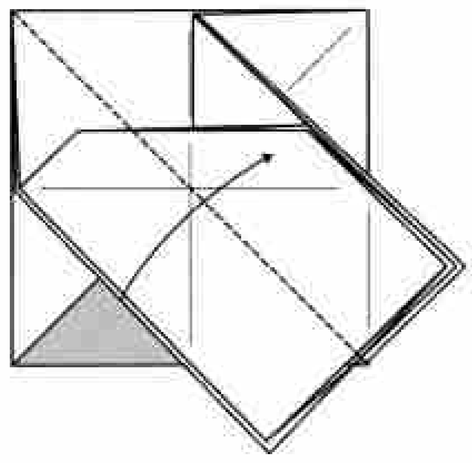
28



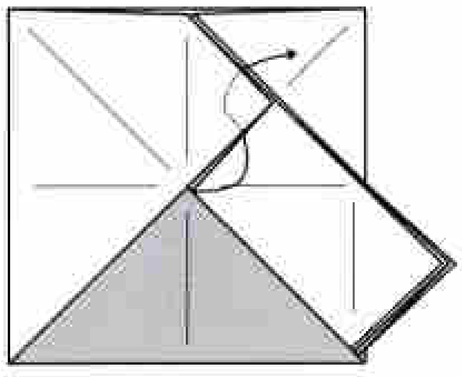
29



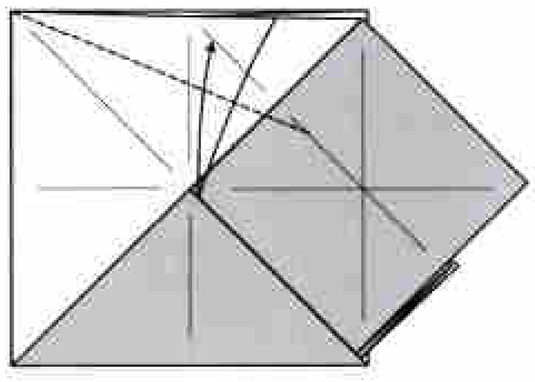
30



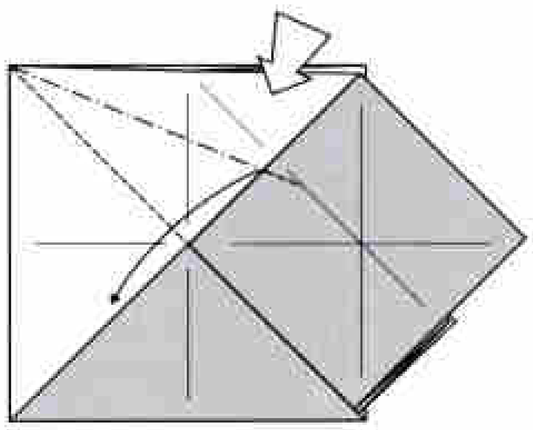
31



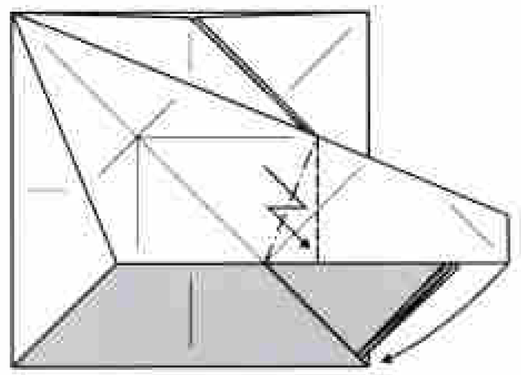
32



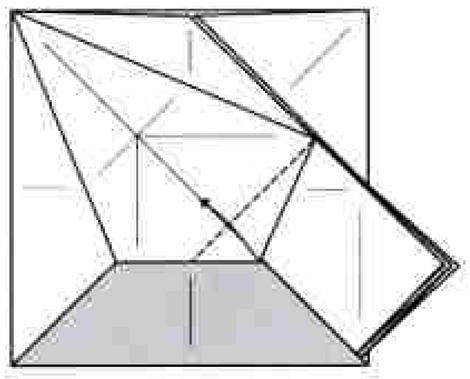
33



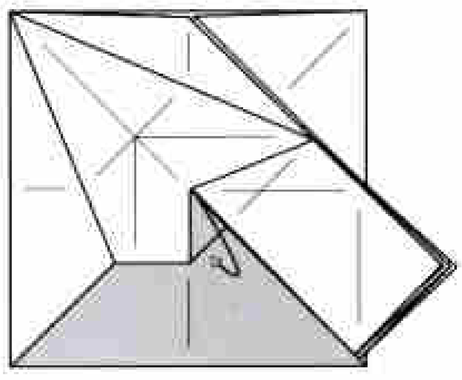
34



35



36



31
Undo the inside reverse fold.

32
Angle bisector.

33
Squash.

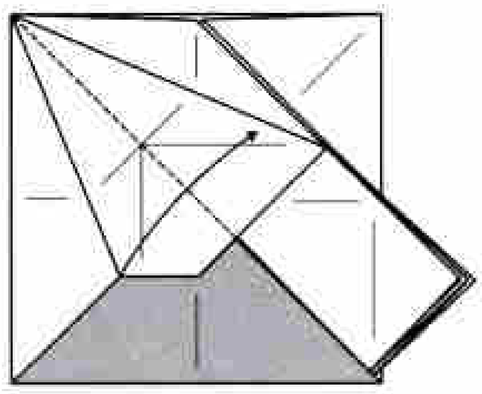
34
Rabbit ear fold.

36
Reverse the flap inside.

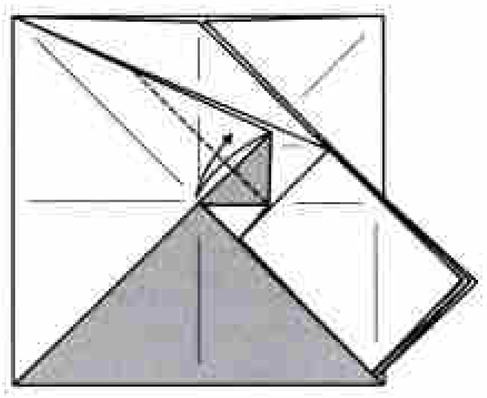
41

Valley fold.
Repeat steps
31 to 41 on the
right side.

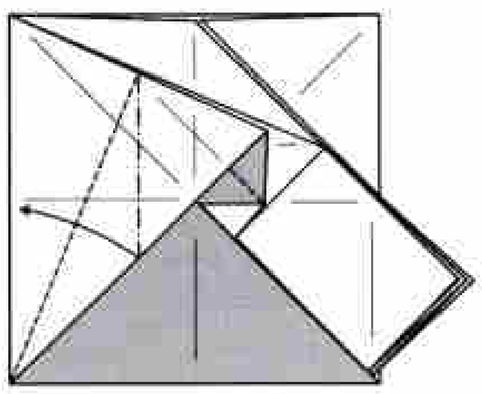
37



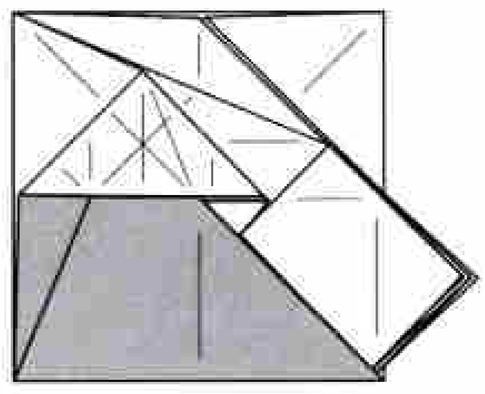
38



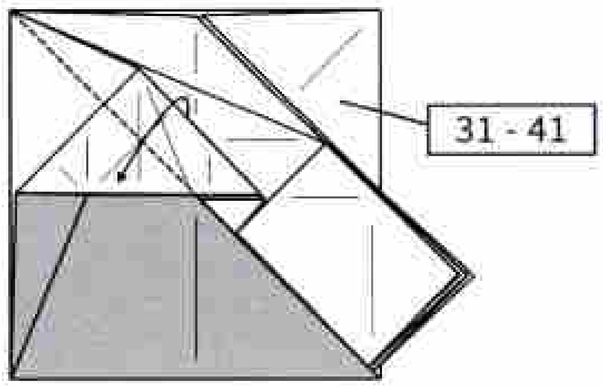
39



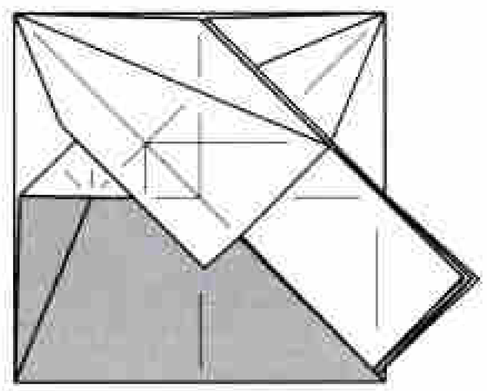
40



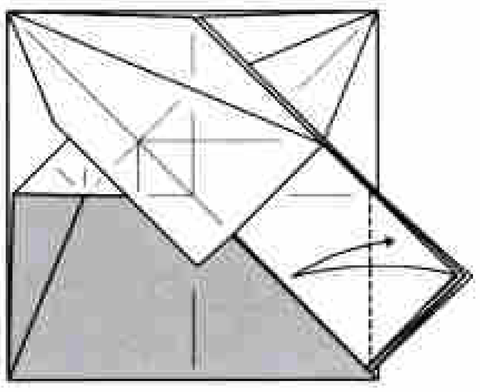
41



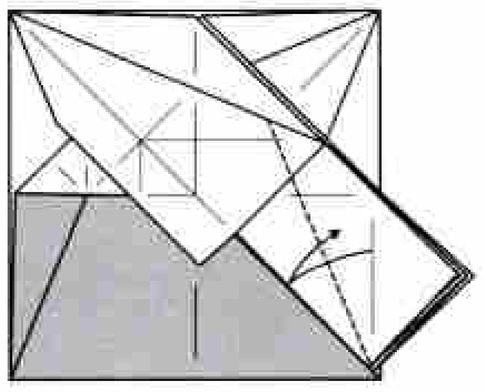
42



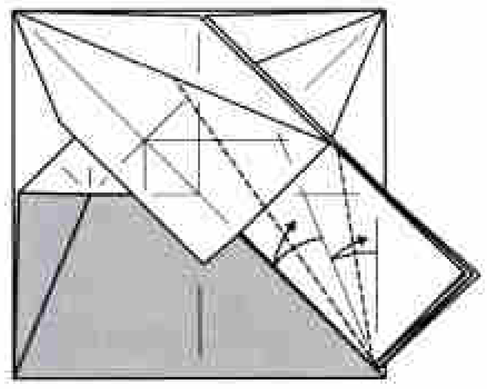
43



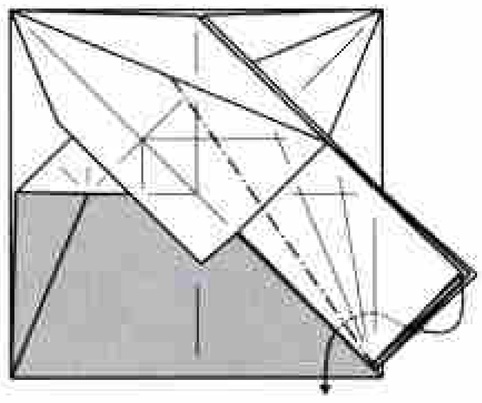
44



45



46

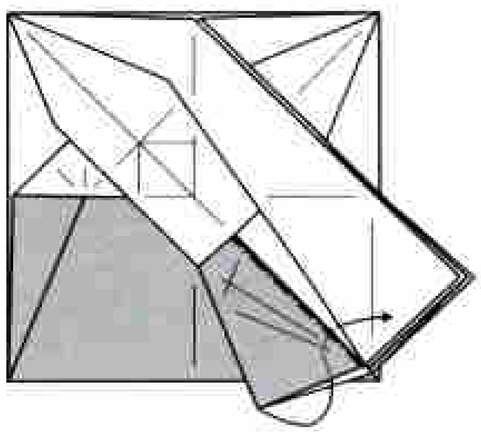


46
Inside reverse fold.

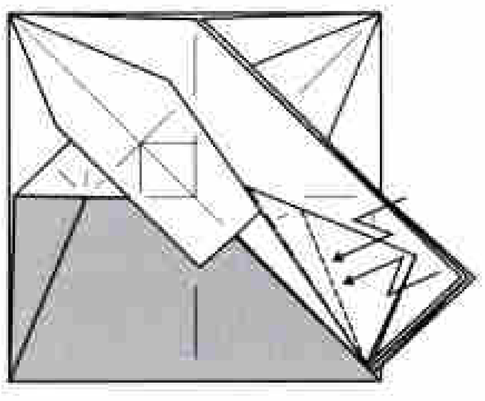
47
Reverse.

48
Crimp.

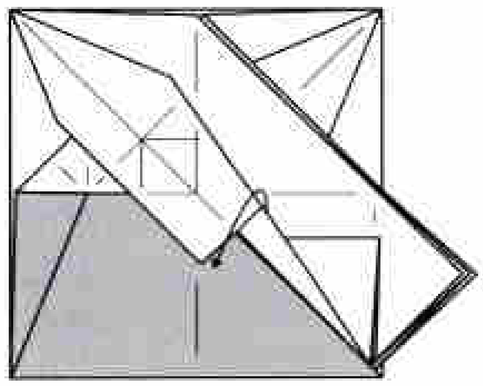
47



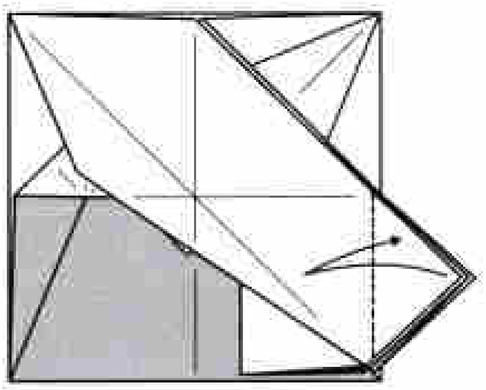
48



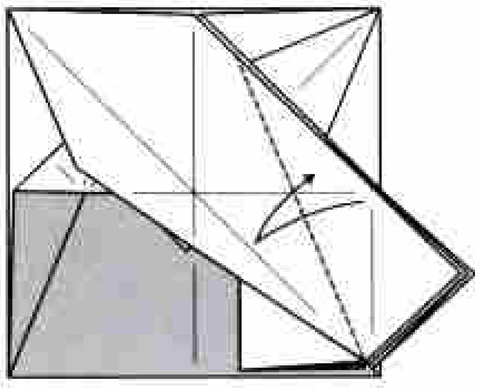
49



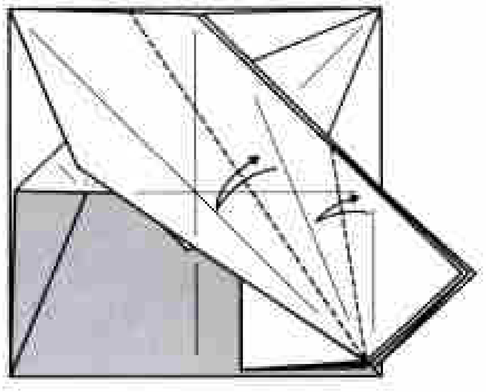
50



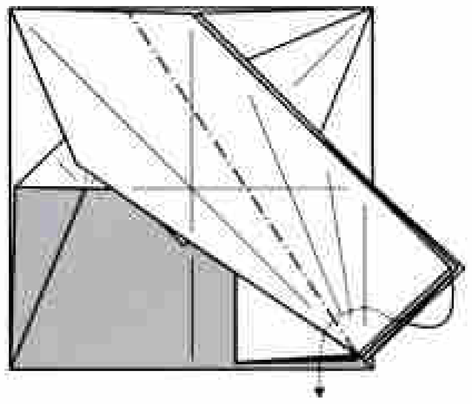
51



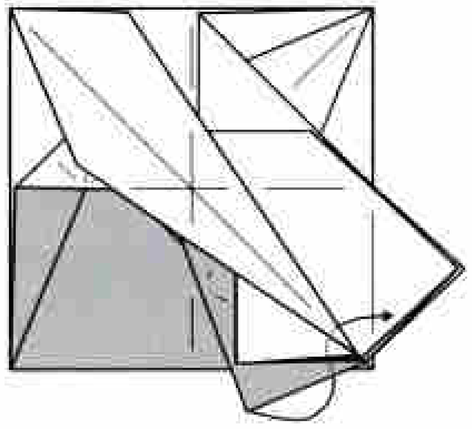
52



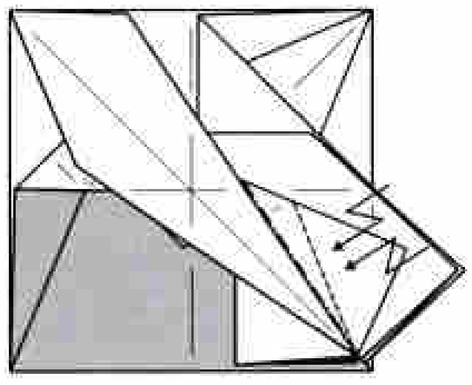
53



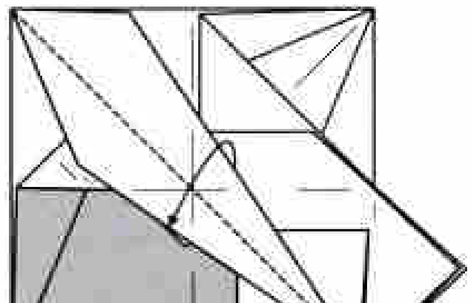
54



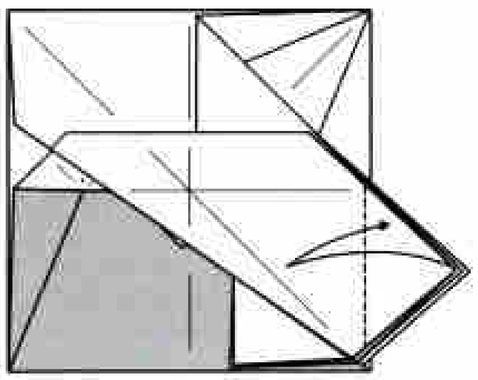
55



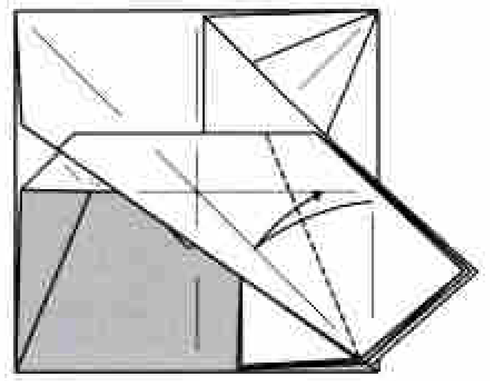
56



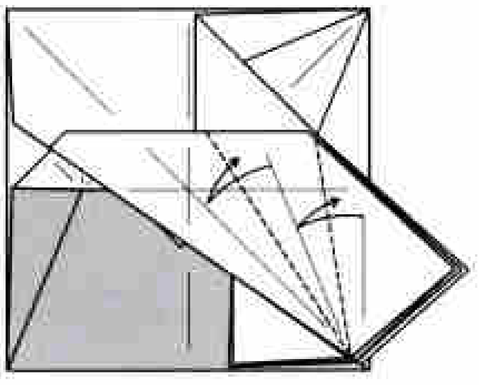
57



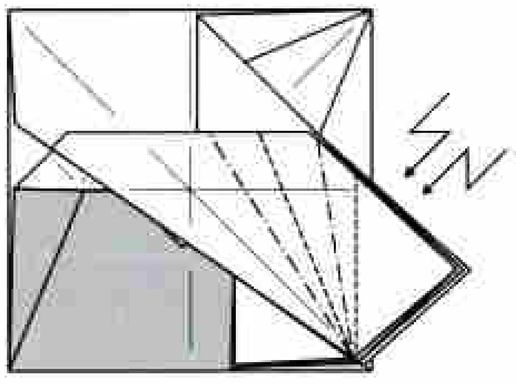
58



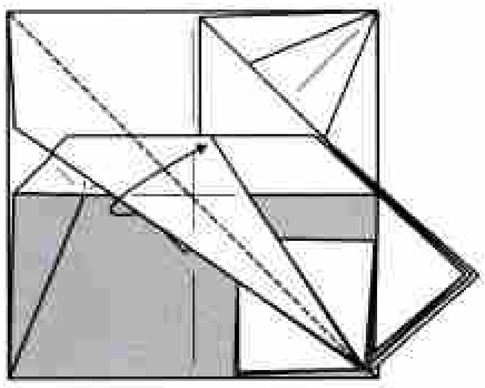
59



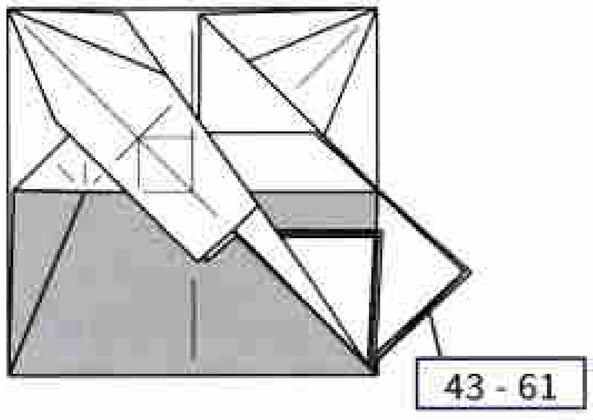
60



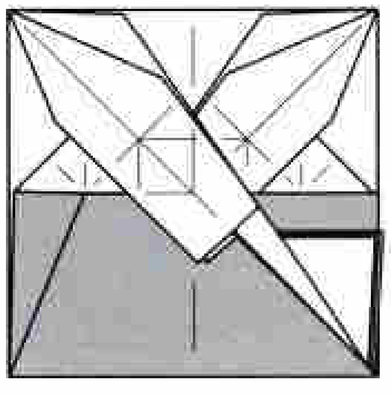
61



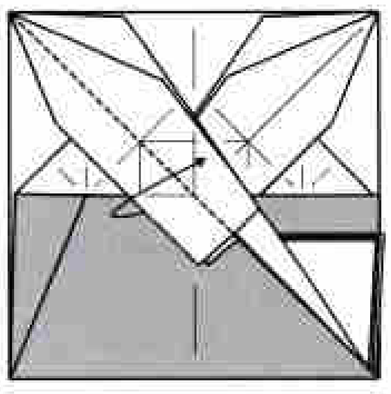
62



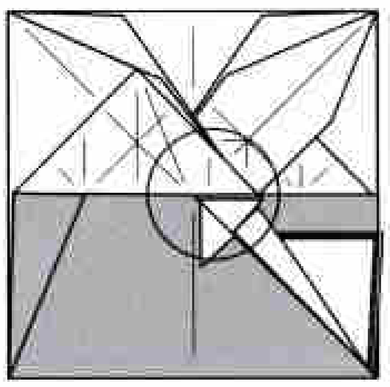
63



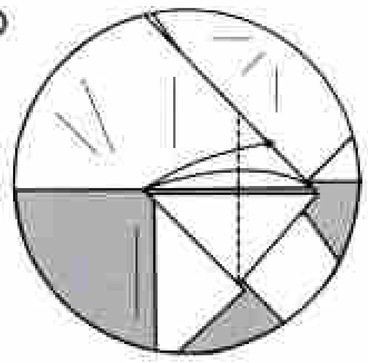
64



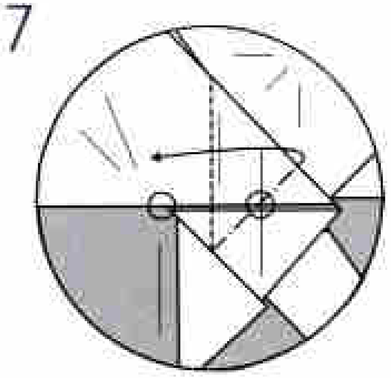
65



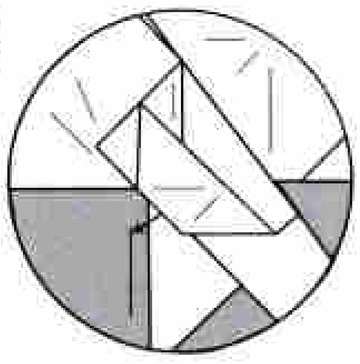
66



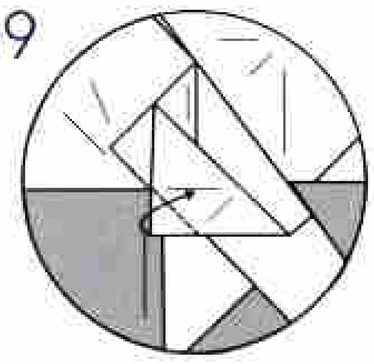
67



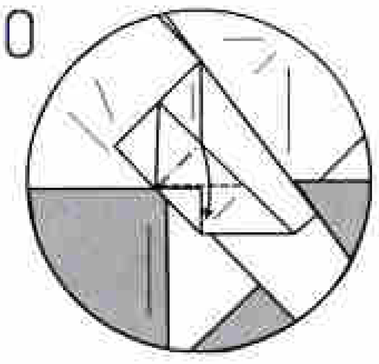
68



69



70



62
Repeat steps 43 to 61 on the right side.

67
Bring reference points together.

68
Pull out paper.

70
Squash.

74
Mountain fold.

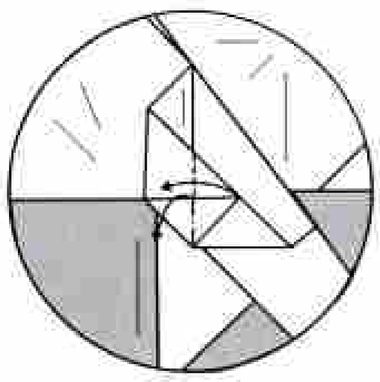
76
Repeat steps 64 to 75 on the right side.

78
Inside reverse fold middle flap.

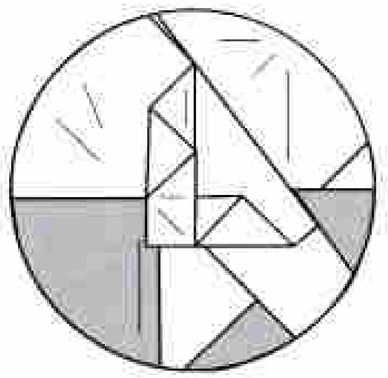
79
Fold and unfold through all layers. Use reference point.

80
Shape into cylinder. Insert right flap into left pocket.

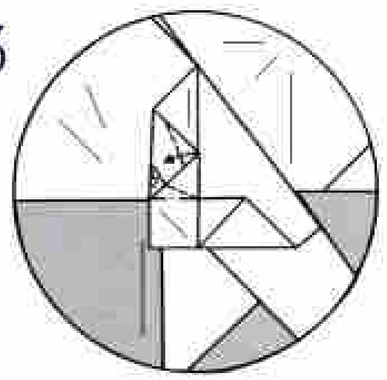
71



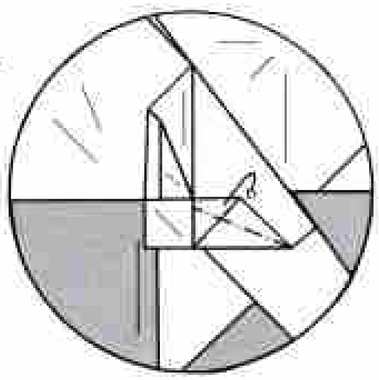
72



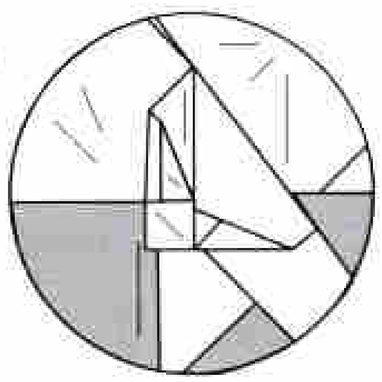
73



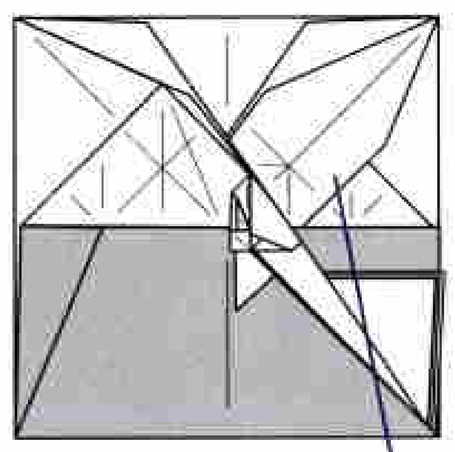
74



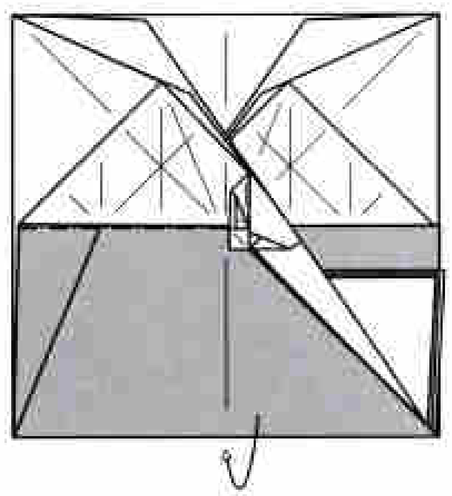
75



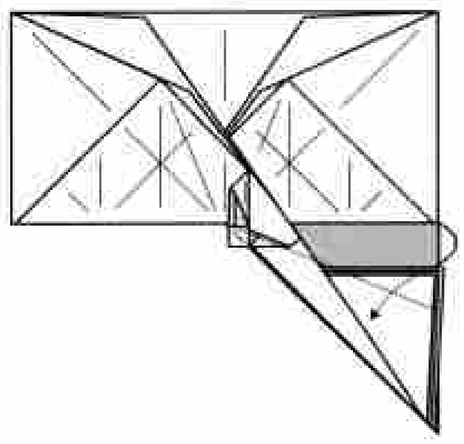
76



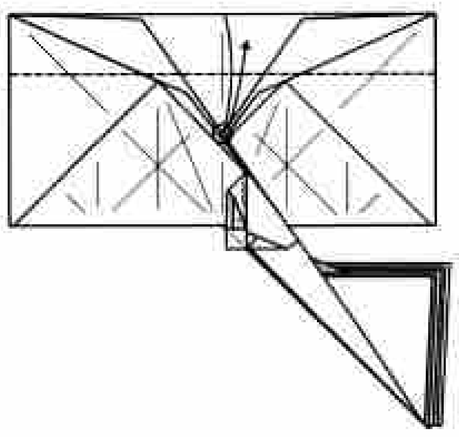
77



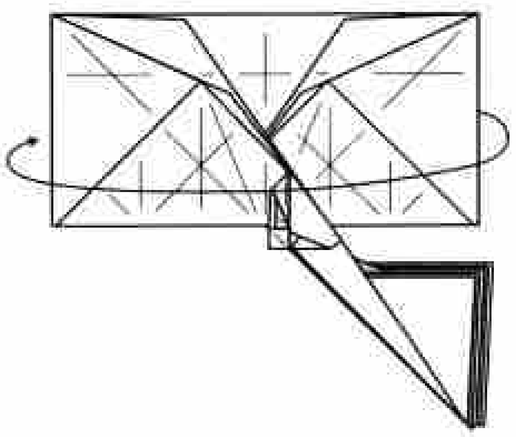
78



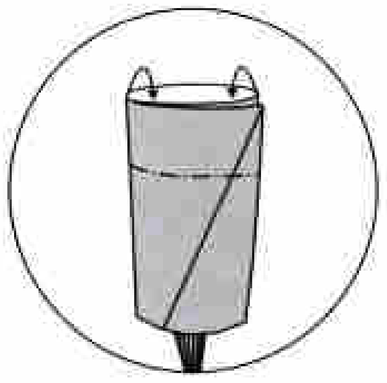
79



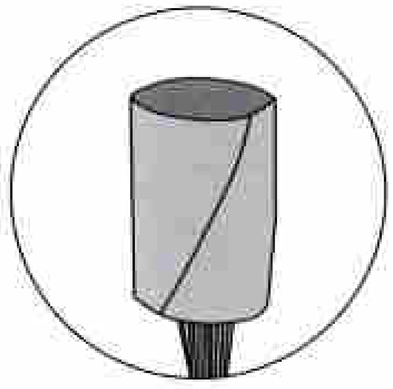
80



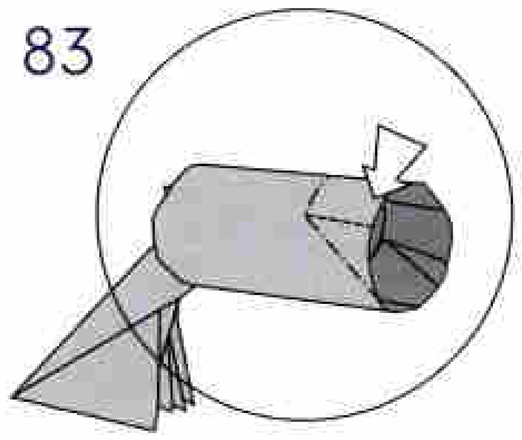
81



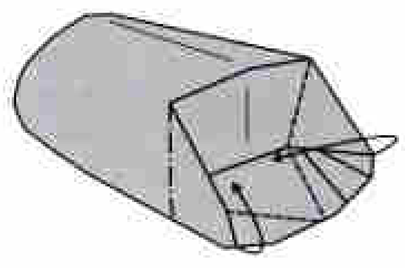
82



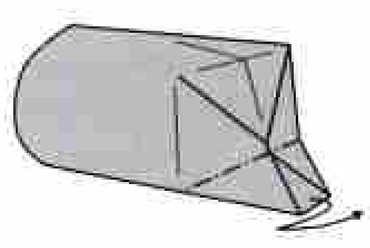
83



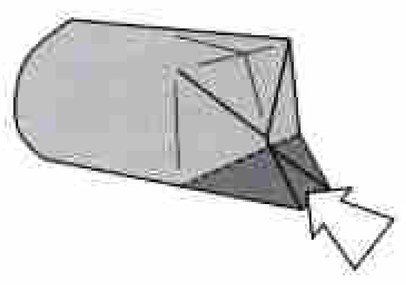
84



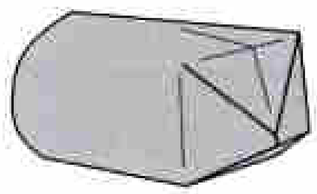
85



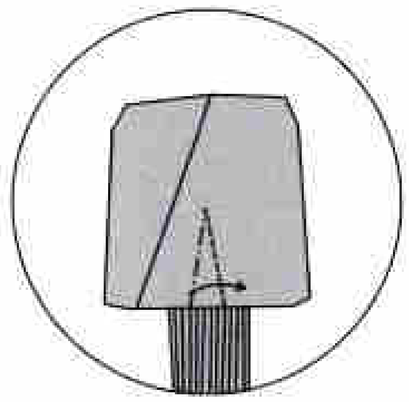
86



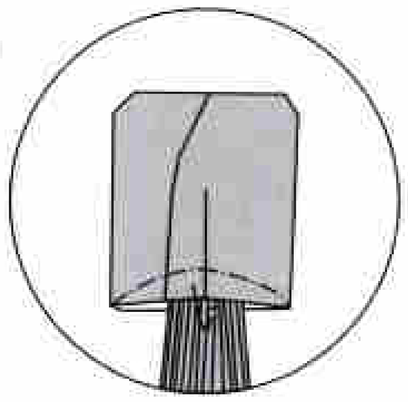
87



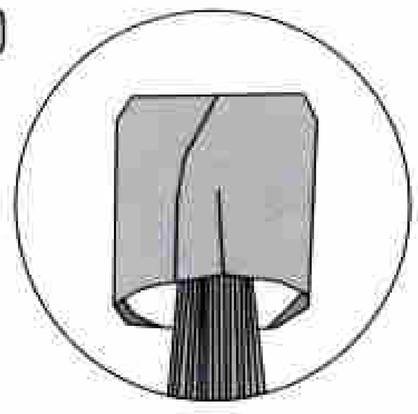
88



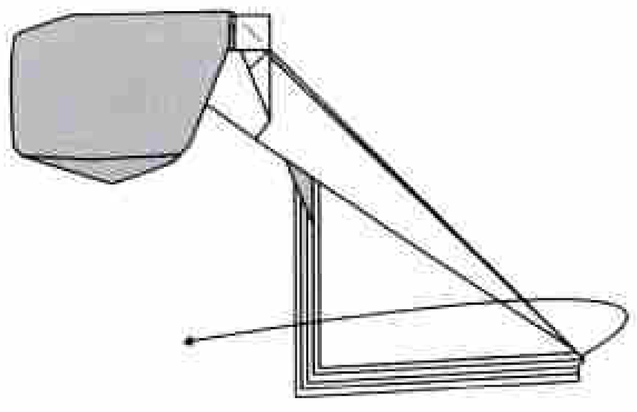
89



90



91



81
Fold inside.

83
Collapse as shown.

85
Fold and unfold.

86
Sink inside.

88
Crimp.

89
Mountain fold.

92
Shape as shown. Dark area is exposed.

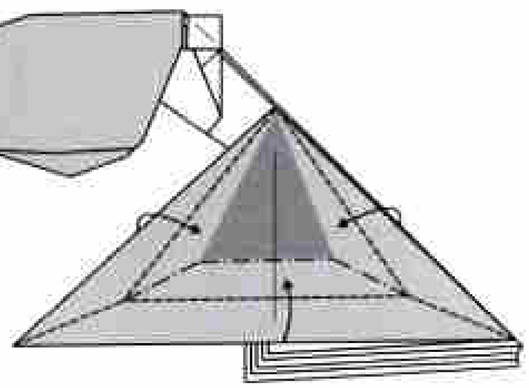
93
Mountain fold. Repeat on other tentacle.

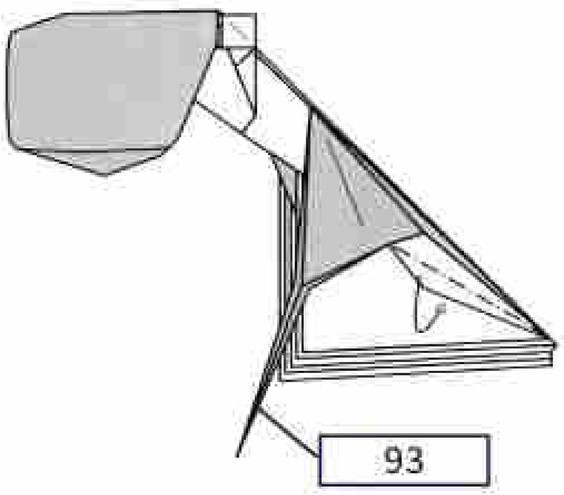
94
Repeat steps 92 to 93 two more times on the same side. Then, repeat three times on the other side.

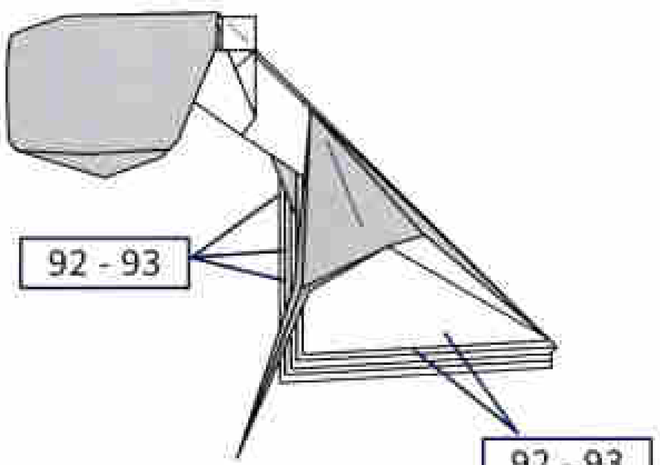
96
Underside view.

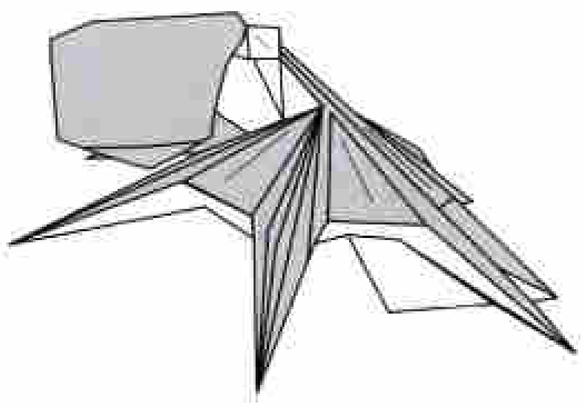
98
Mountain folds.

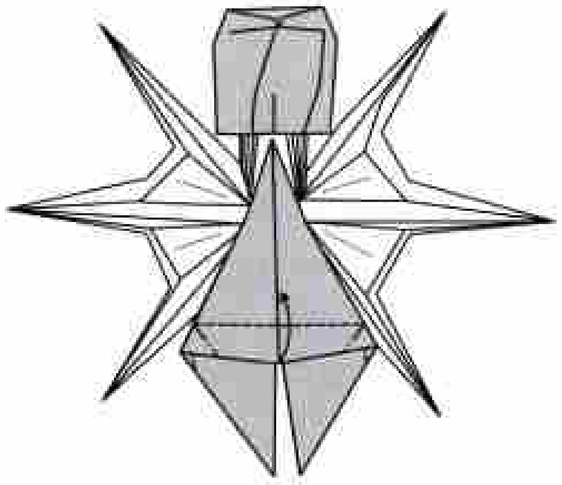
99
Mountain folds.

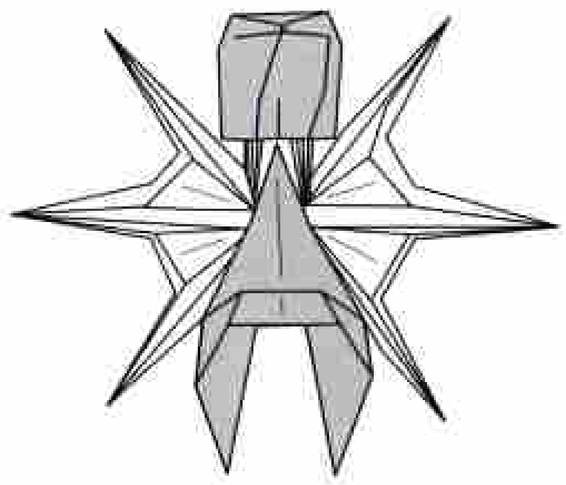
92


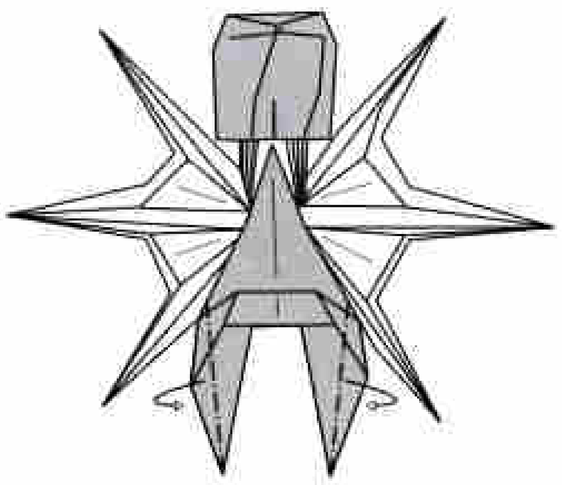
93


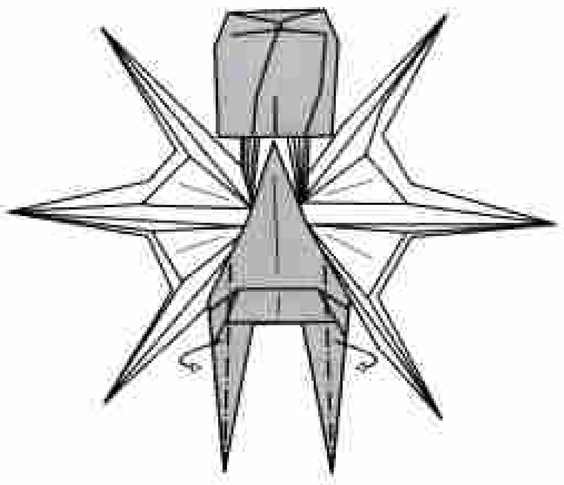
94


95


96


97


98


99


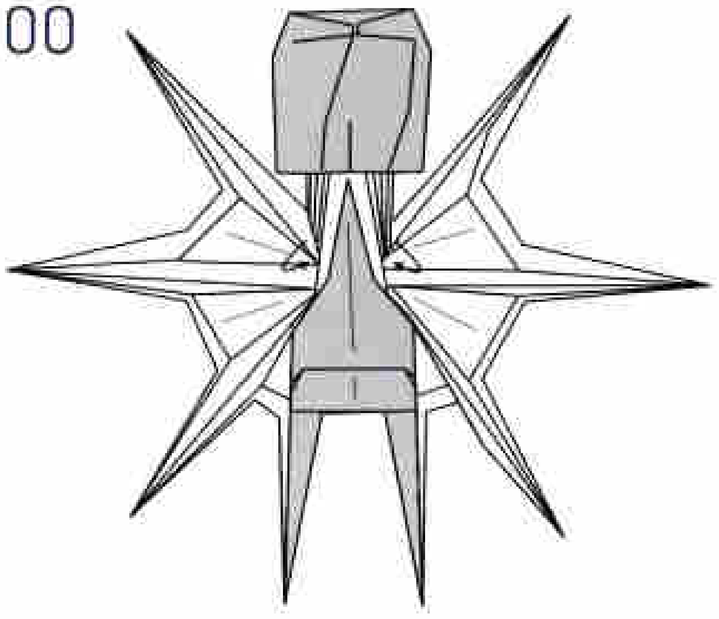
100
Valley folds to lock the layers.

101
Valley folds completed.

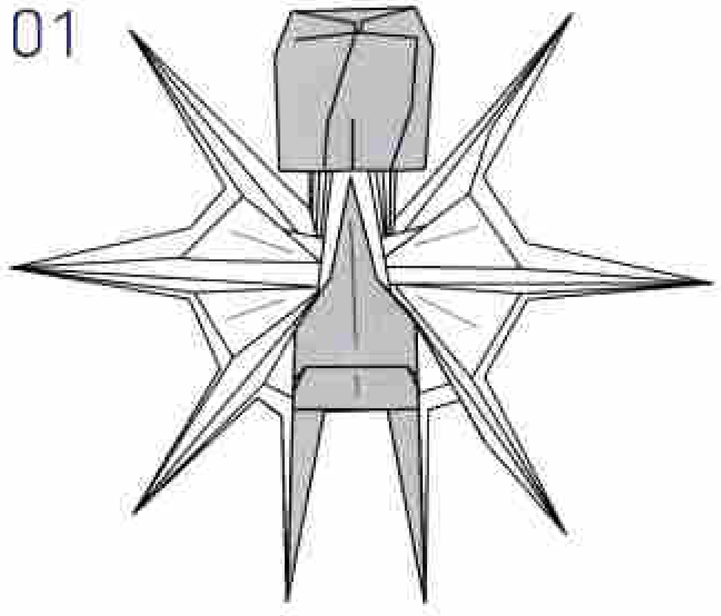
102
Shape.

103
Octopus completed.

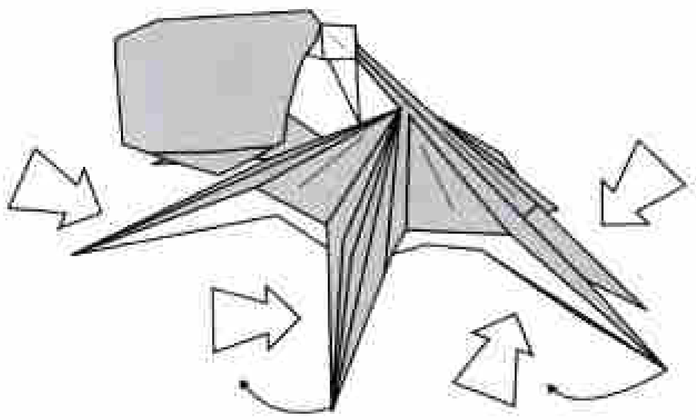
100



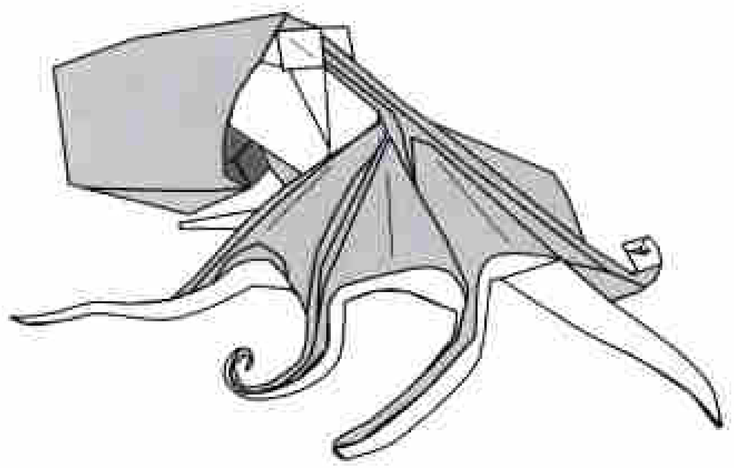
101



102



103



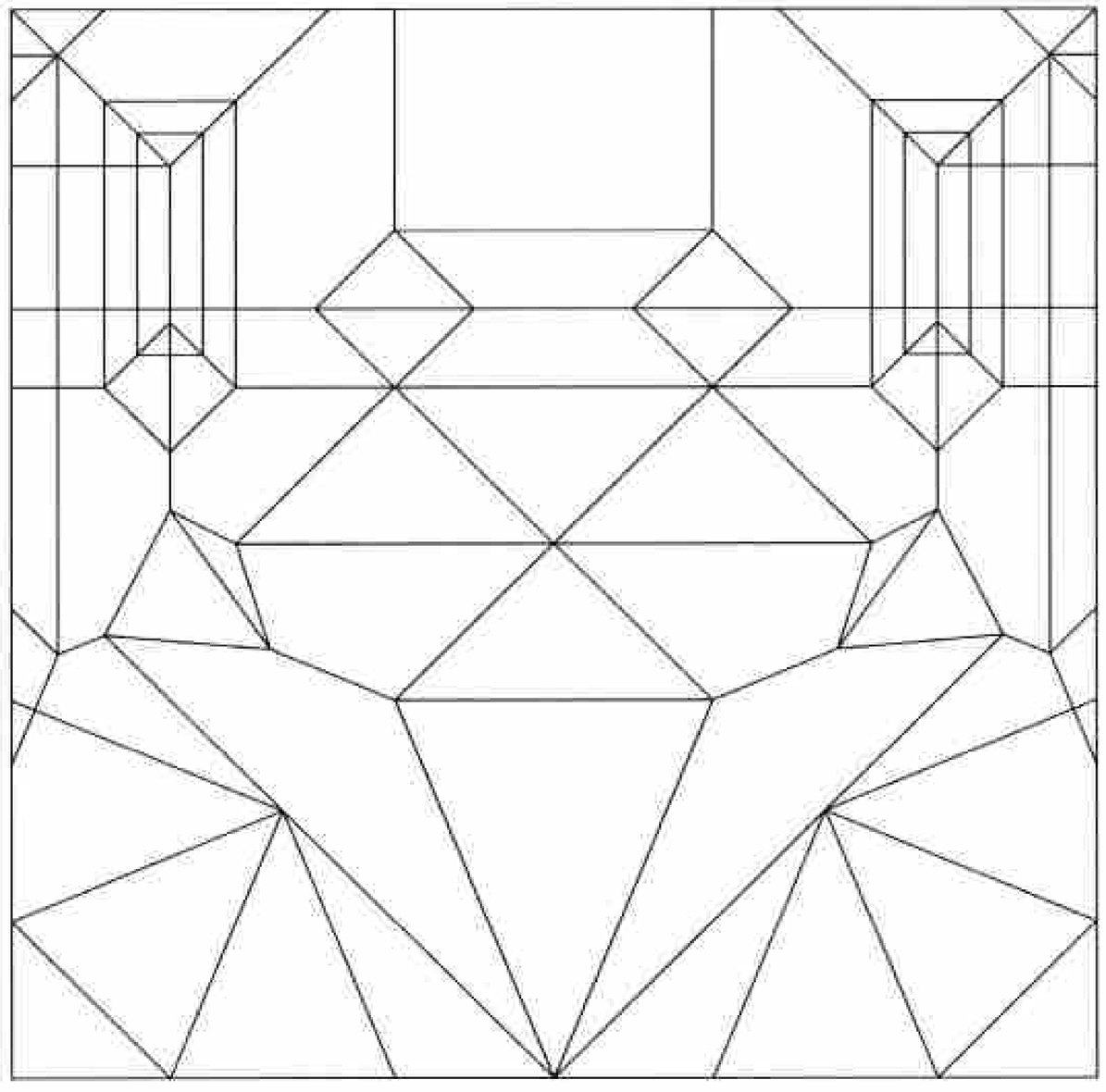




Dumbo Octopus

An initial design idea for this model was to form the small individual tentacles from the corners of an octagon. To do this, I split the square sheet of paper into two sections; the top part I turned into the head and the bottom into the octagon. The folding process begins in two dimensions then transitions into three, where a series of locks and unique folds create the lifted head section.

Use one colored paper for this model.







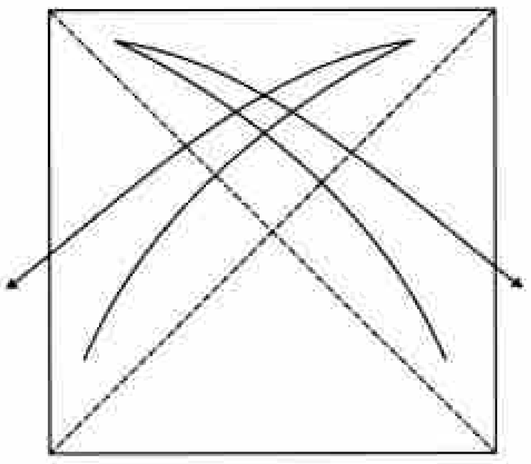
9

Repeat steps 6 to 8 on the left side.

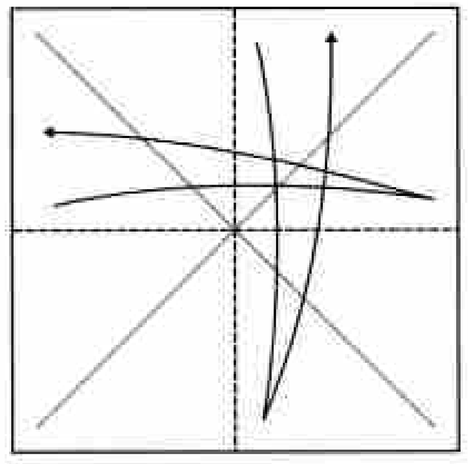
11

Flip over.

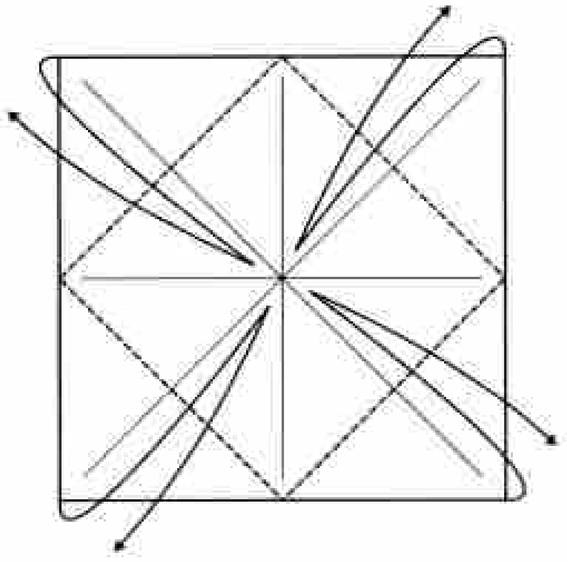
1



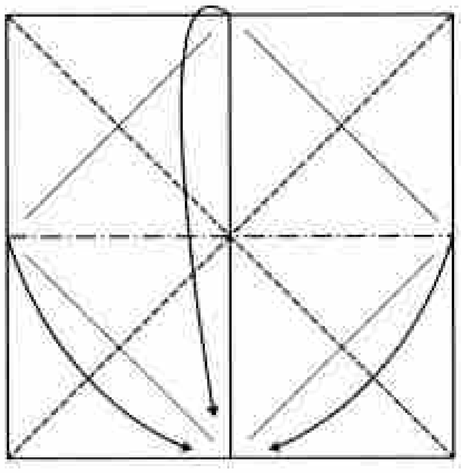
2



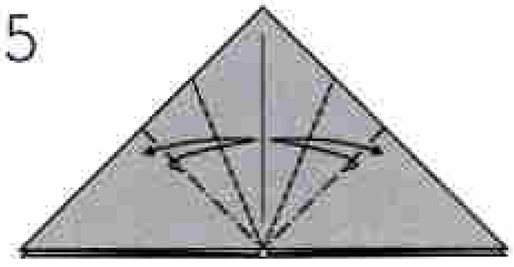
3



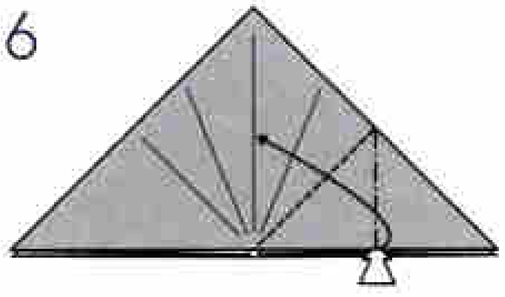
4



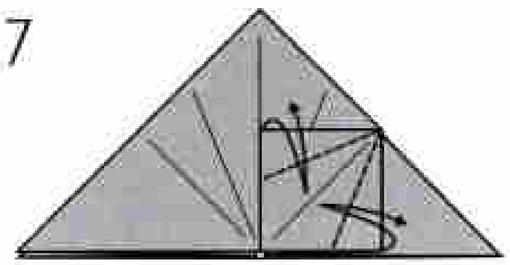
5



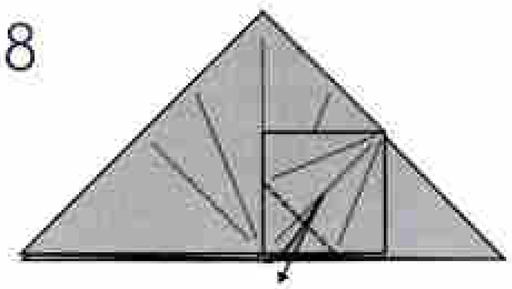
6



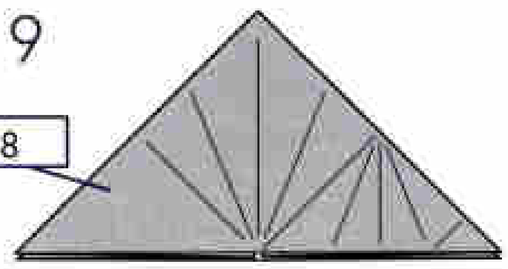
7



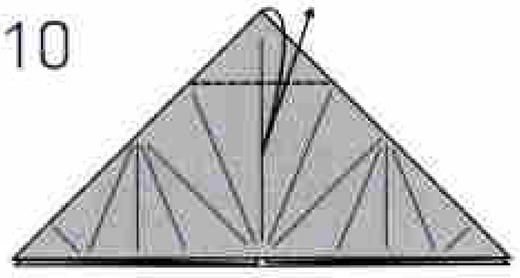
8



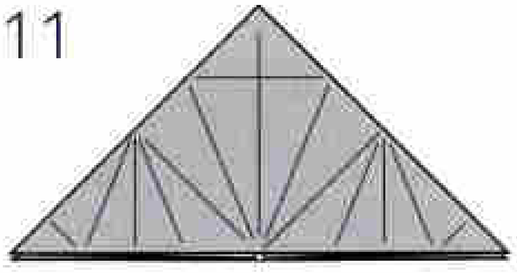
9



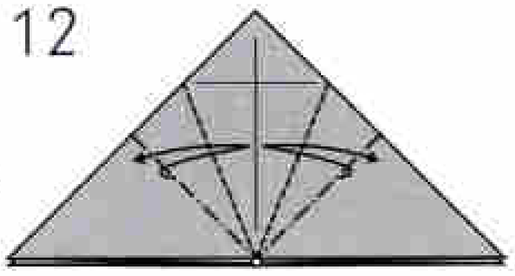
10



11



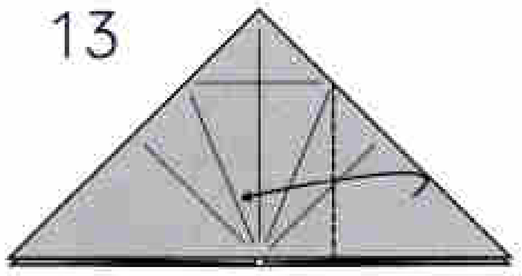
12



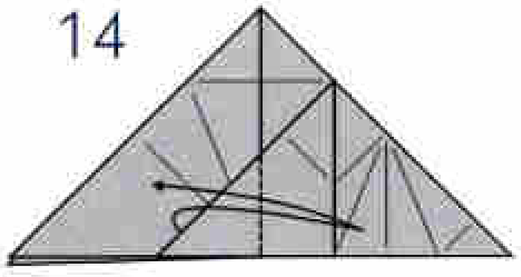
15
Repeat steps 13 to 15 on the left side.

16
Unfold everything.

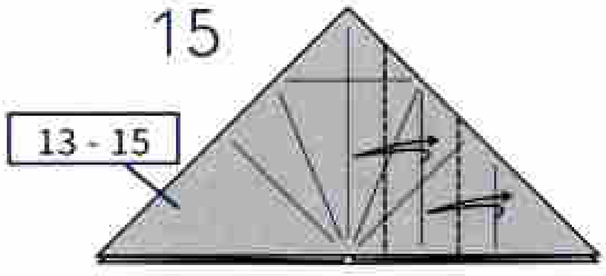
13



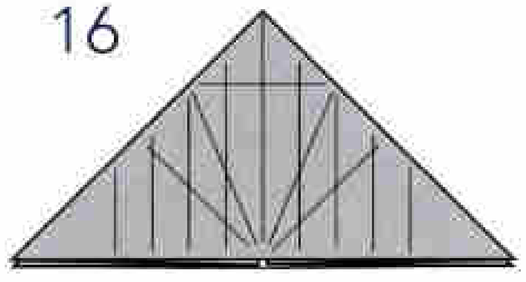
14



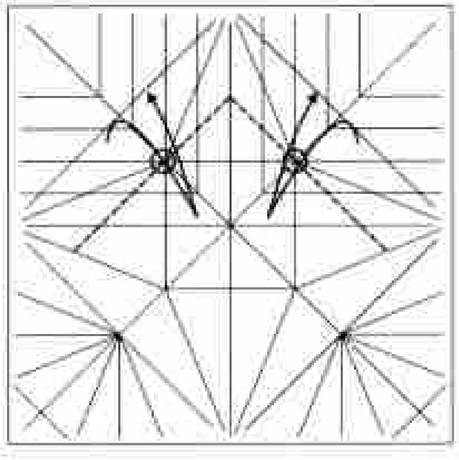
15



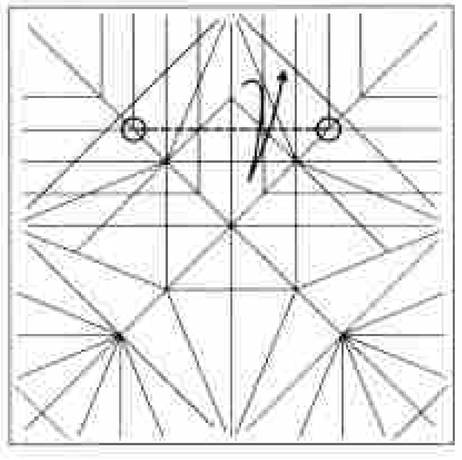
16



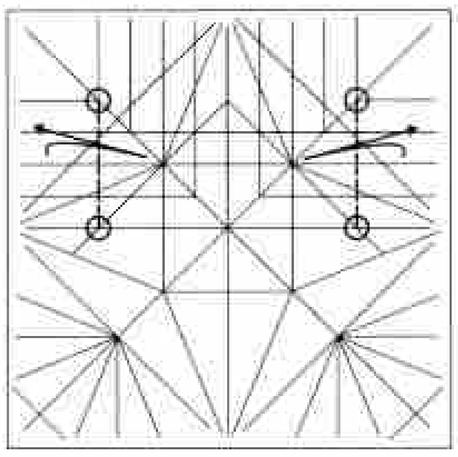
17



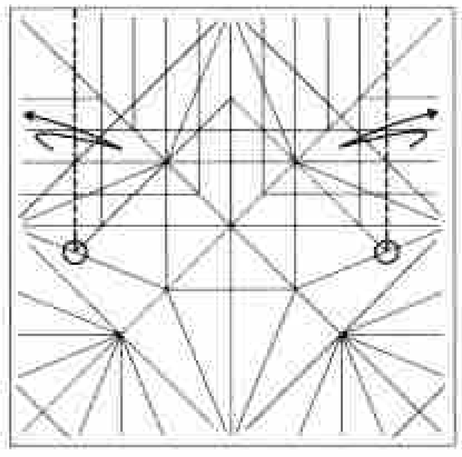
18



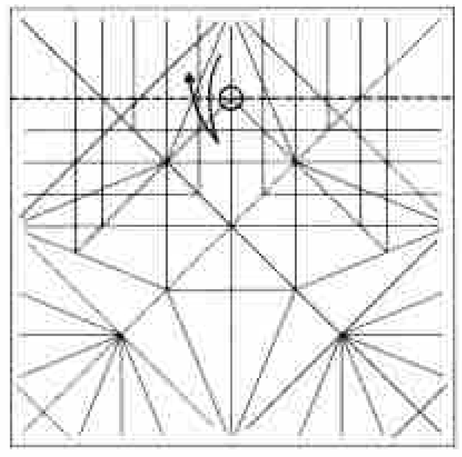
19



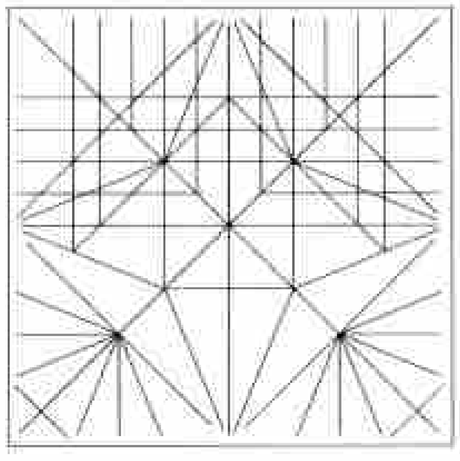
20



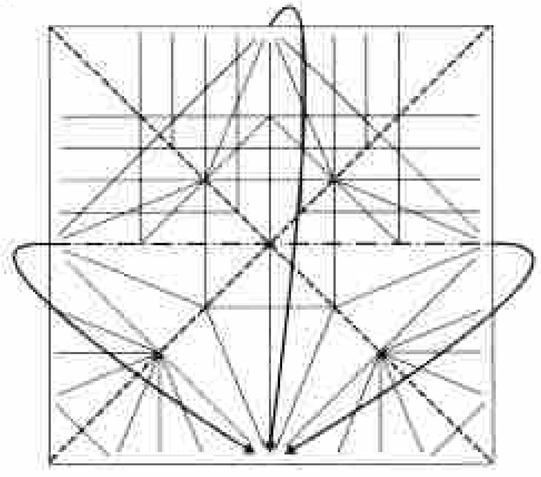
21



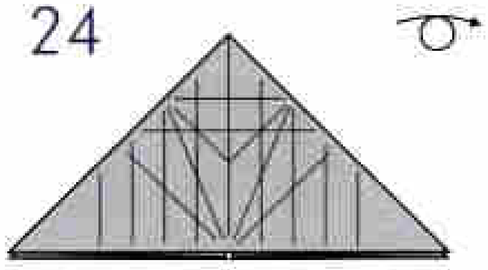
22



23



24



25
Petal fold.

27
Flip over.

28
Valley fold up.

29
In progress.

30
Flatten model.

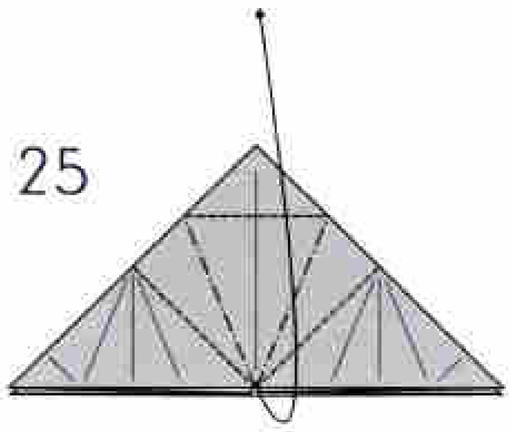
31
Pleat and expand the bottom.

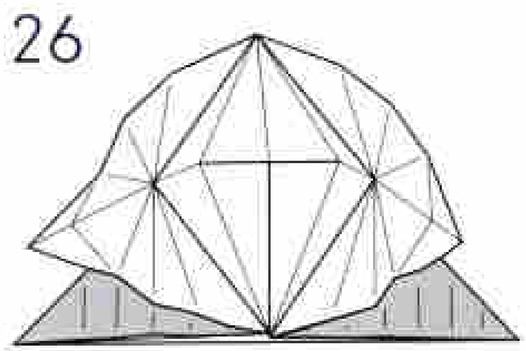
32
Repeat on the left side.

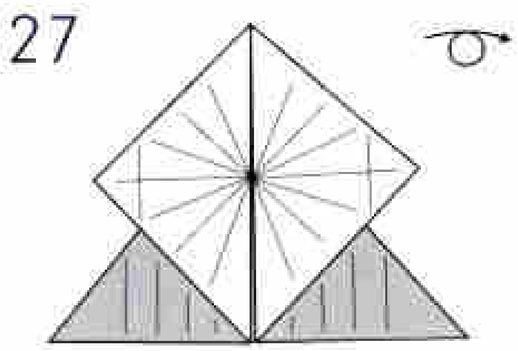
33
Open right side. Squash bottom at arrow.

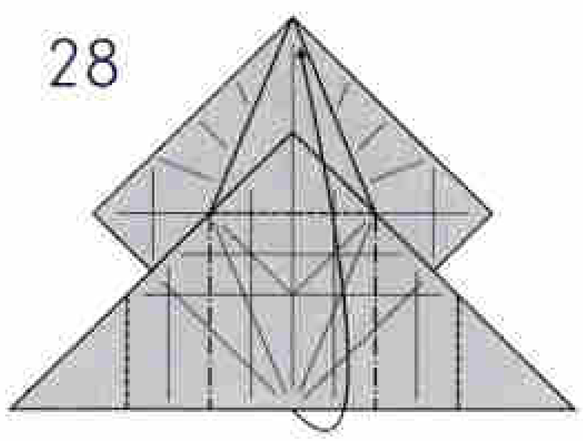
34
Fold and unfold.

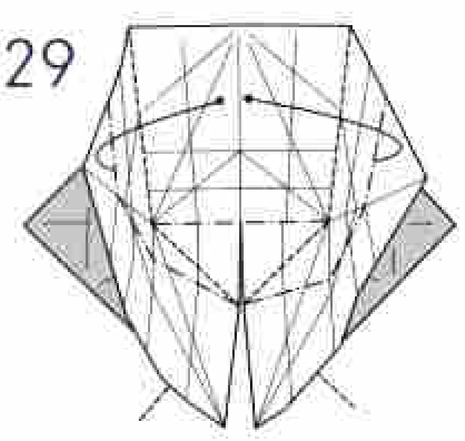
35
Close model. Repeat steps 33 to 35 on the left side.

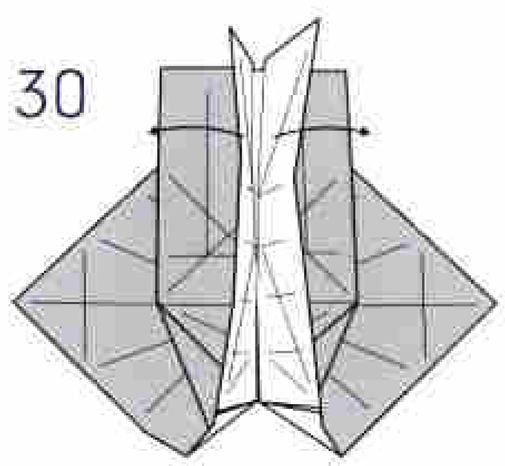


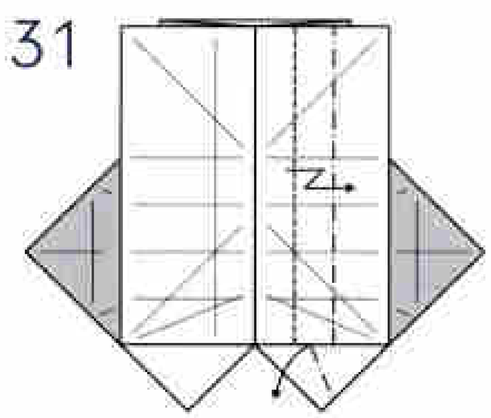


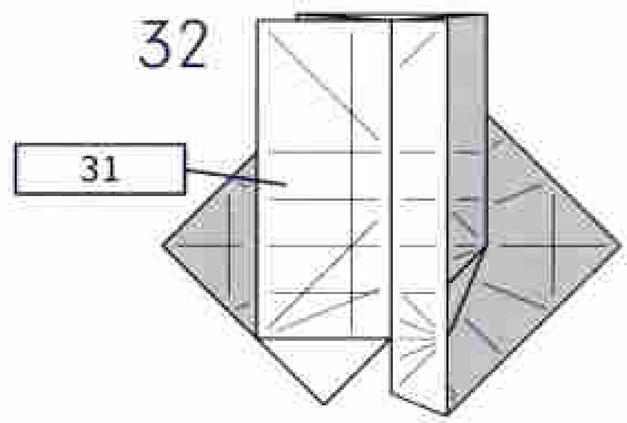


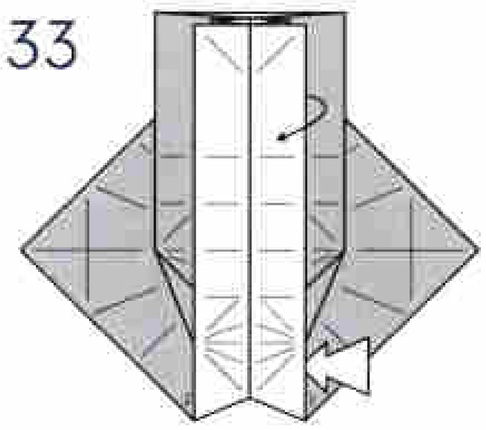


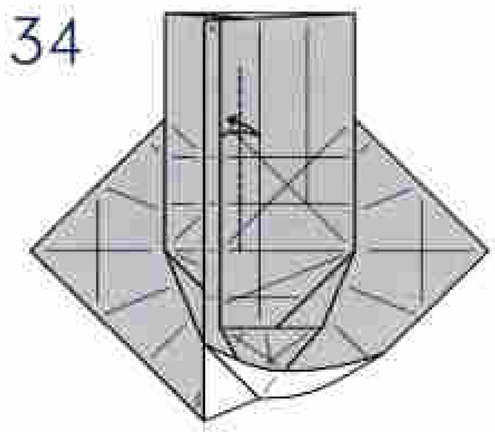


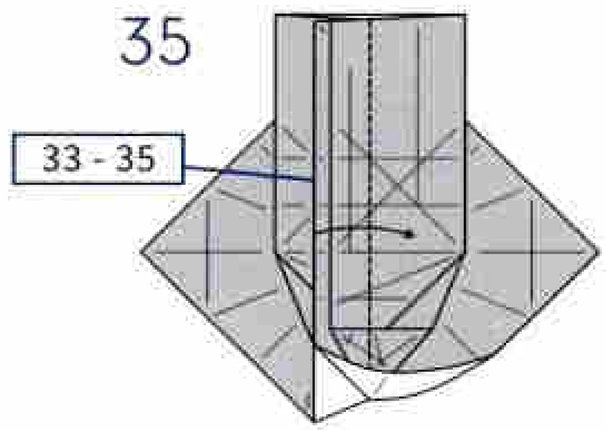


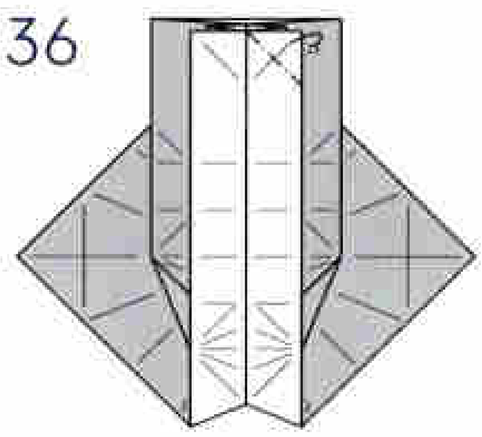




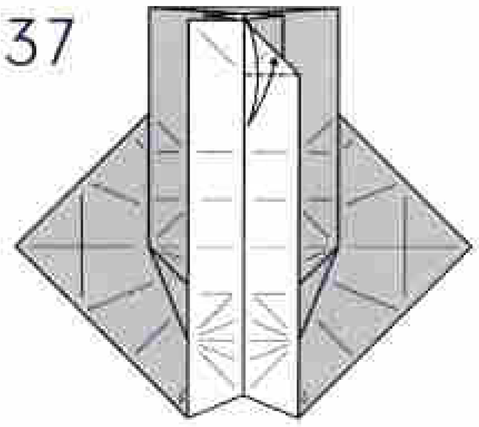




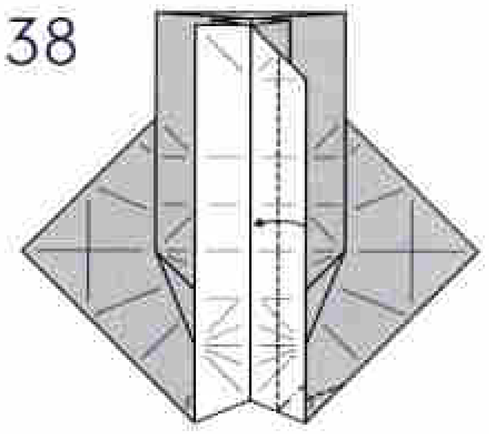




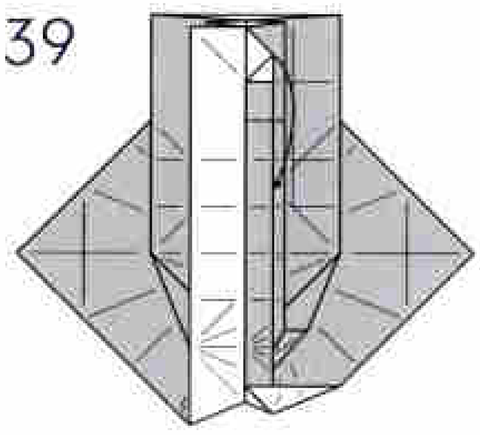
37



38



39



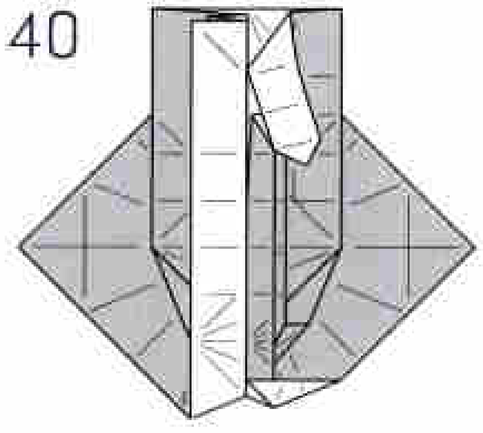
41

Repeat steps 36 to 40 on the left side.

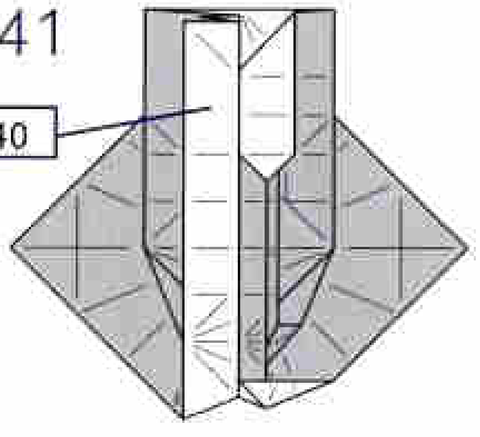
47

Unsink the paper by pushing in the sides.

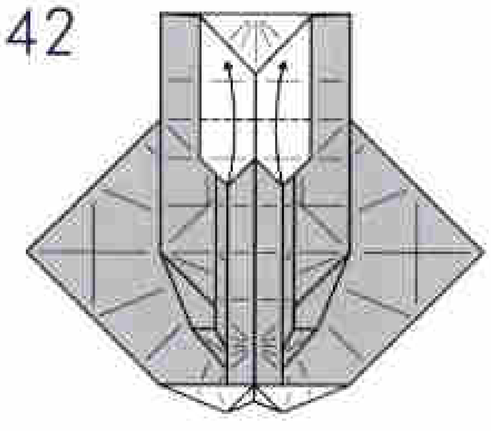
40



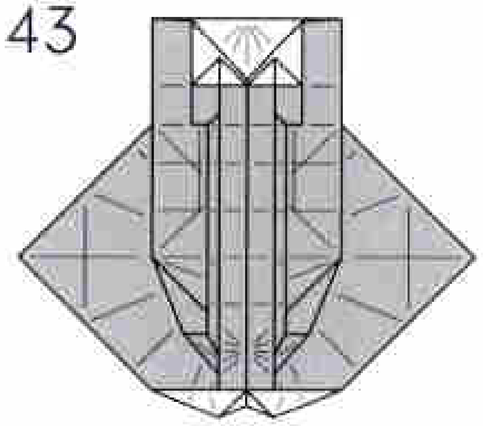
41



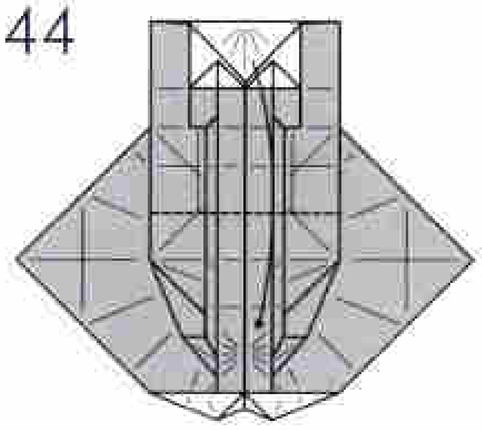
42



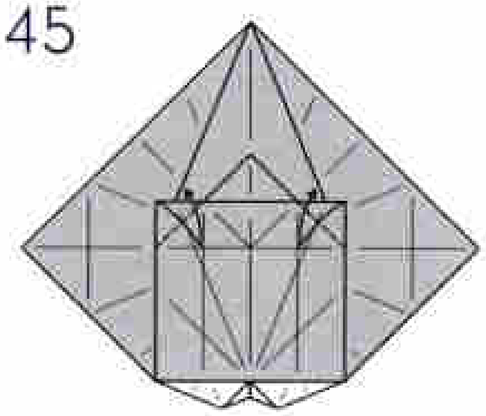
43



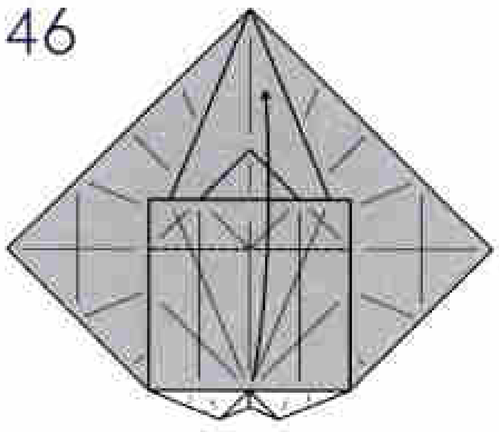
44



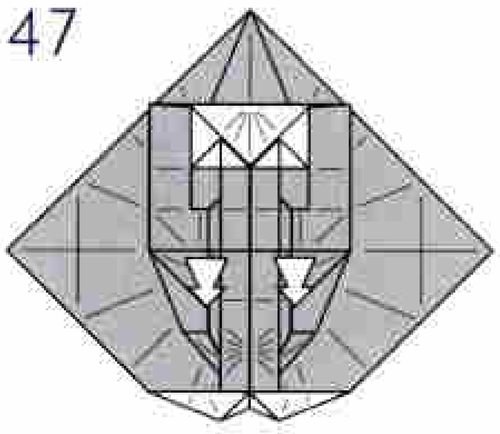
45



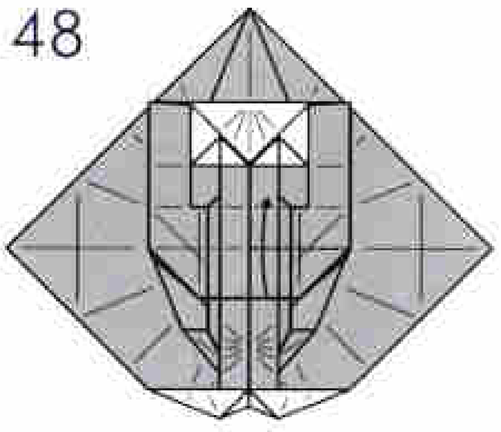
46



47



48



49
Fold an inside reverse fold while bringing the flap down. Unfold after.

50
Push in to extend flap.

51
Pull out paper.

52
Open sink.

53
Unsink flap.

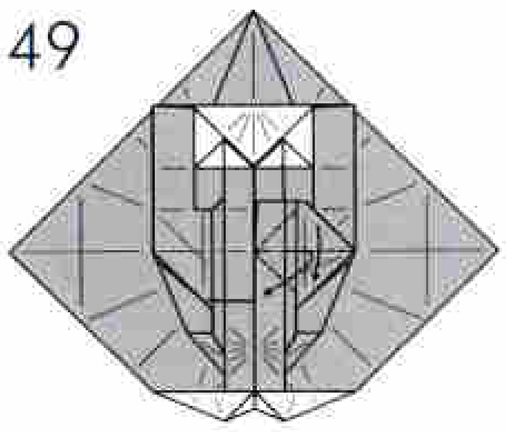
54
Flap unsunk.

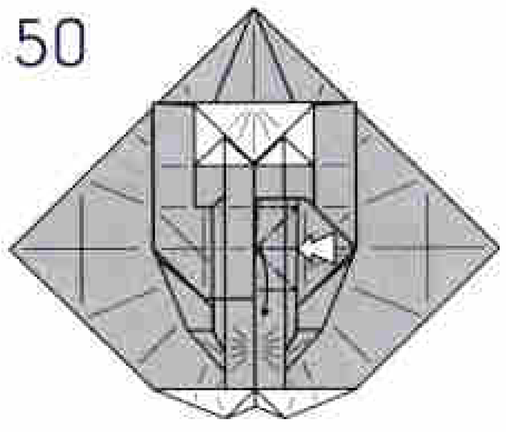
55
Push in.

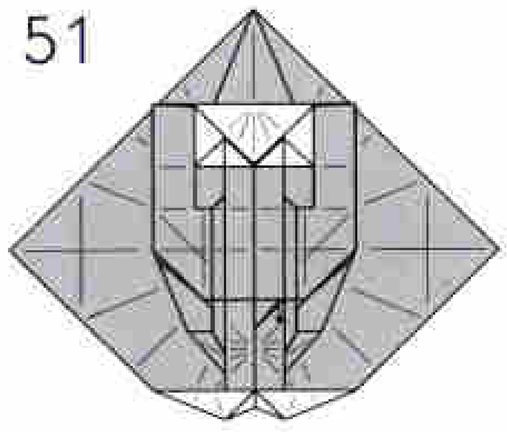
56
Mountain fold inside.

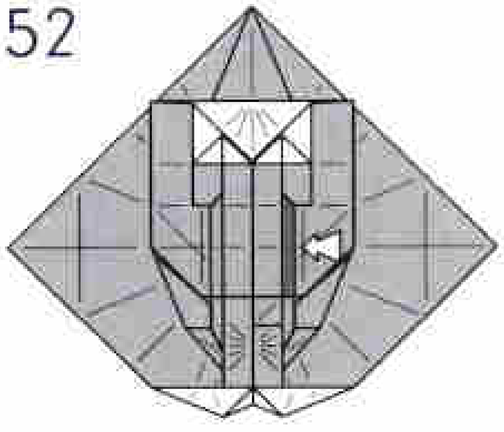
57
Repeat steps 48 to 55 on left side.

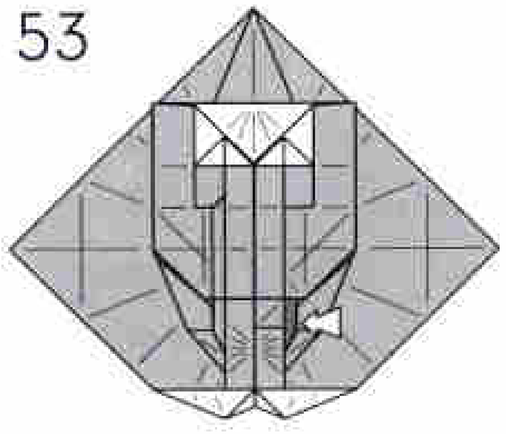
58
Insert left flap into right pocket.

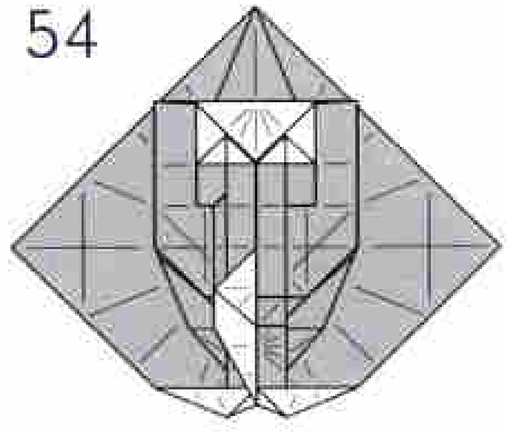


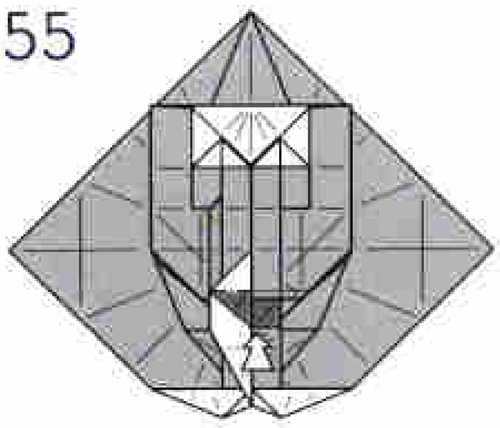


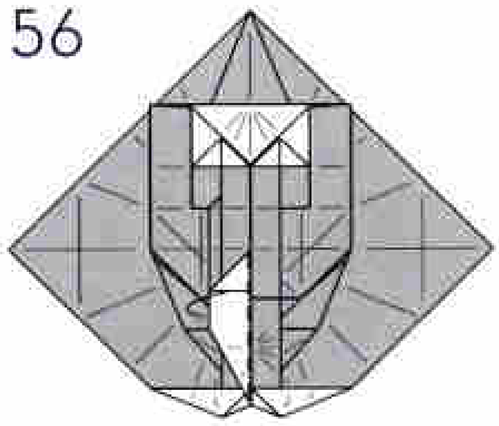


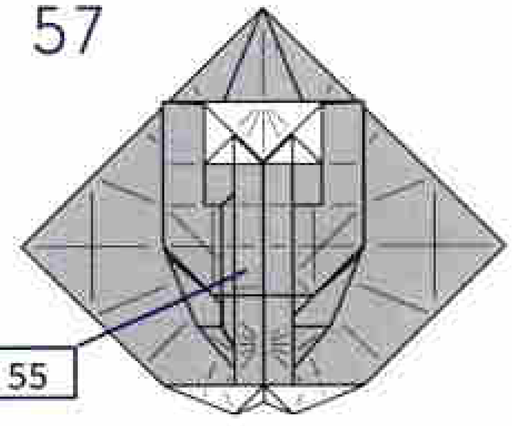


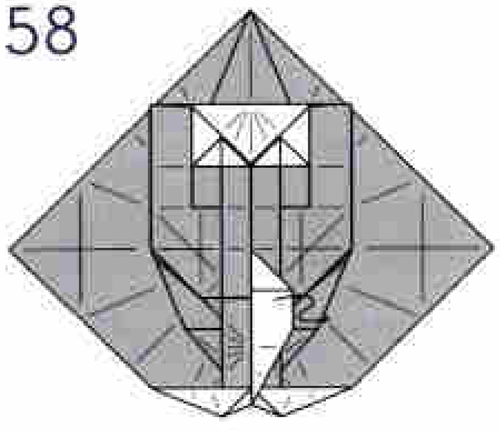


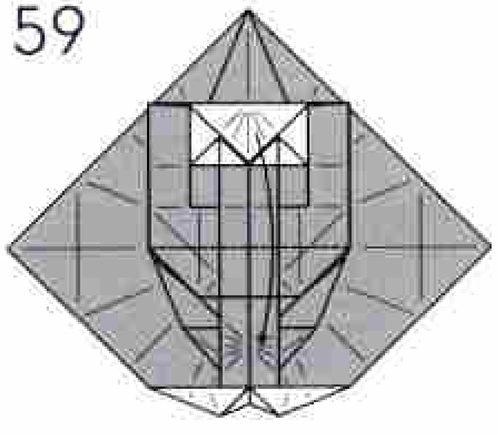


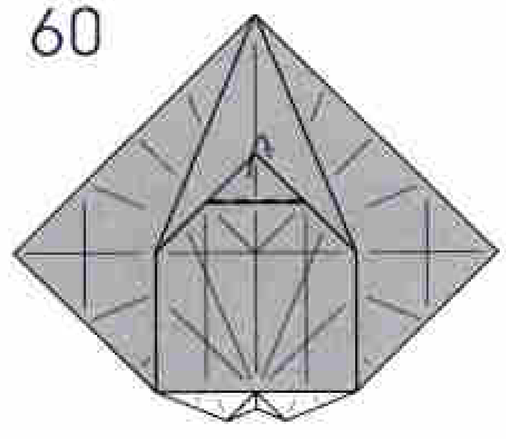




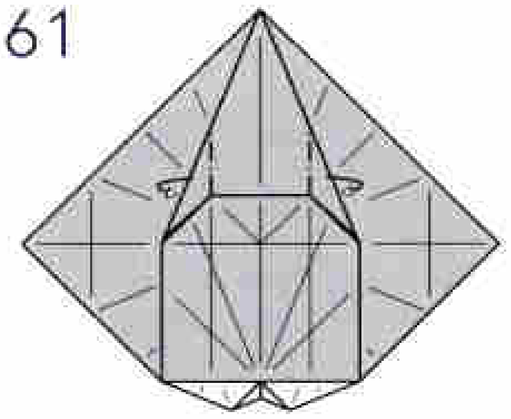




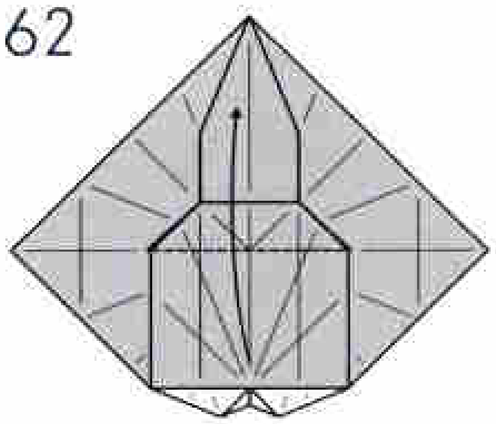




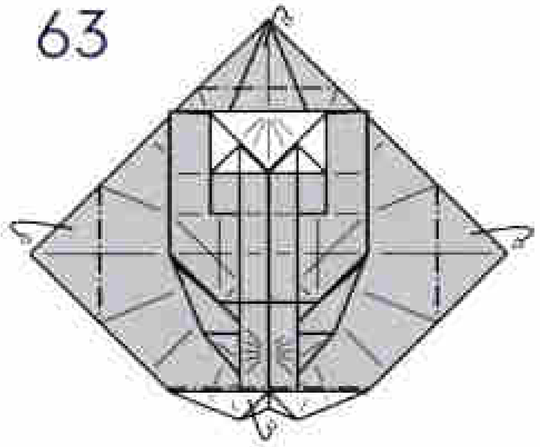
61



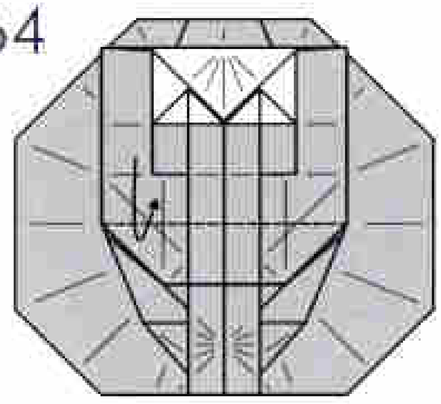
62



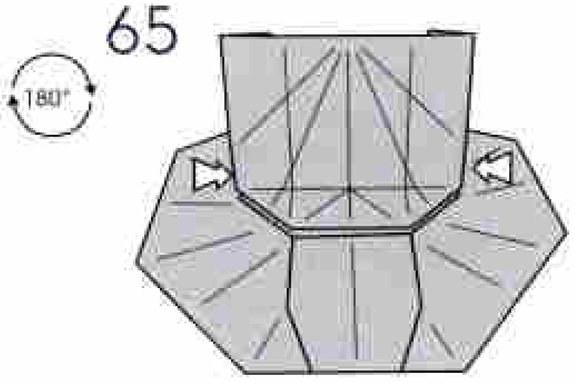
63



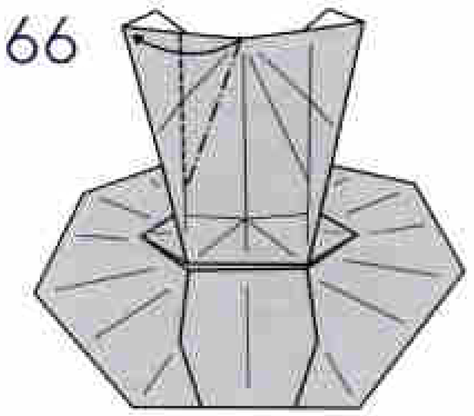
64



65



66



64
Fold head flap up. Rotate.

65
Push in the sides and lift.

66
Crimp.

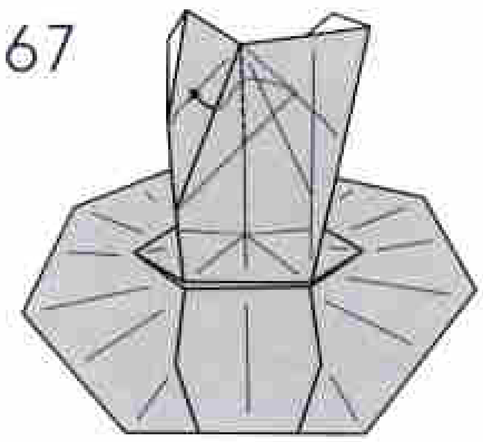
67
Inside reverse fold.

69
Mountain fold both layers to lock.

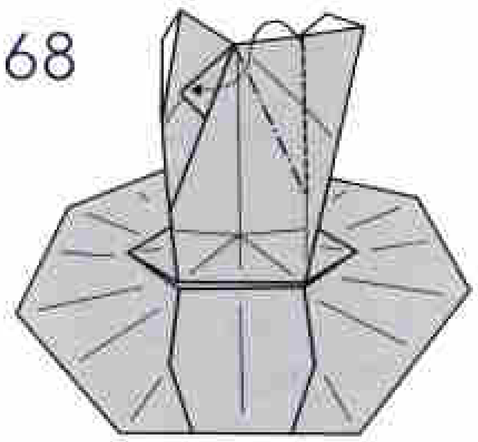
71
Crimp and unfold.

72
Collapse.

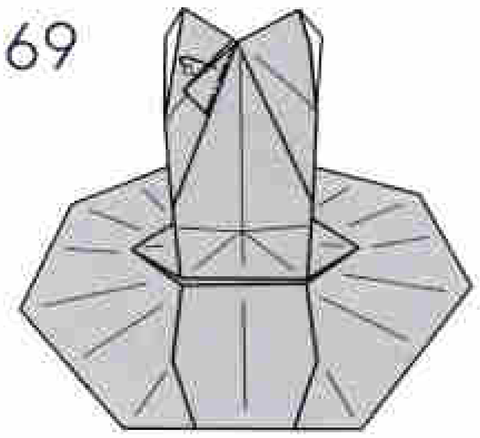
67



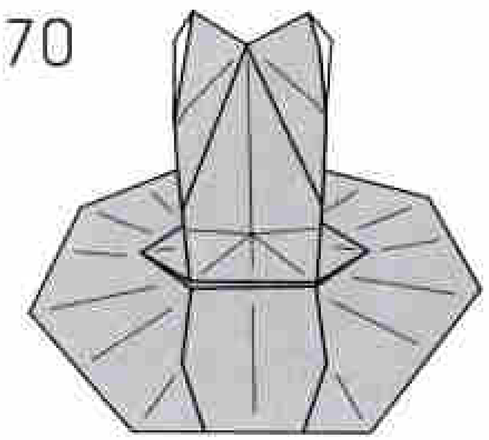
68



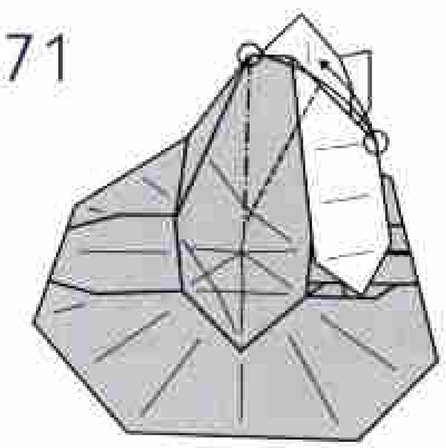
69



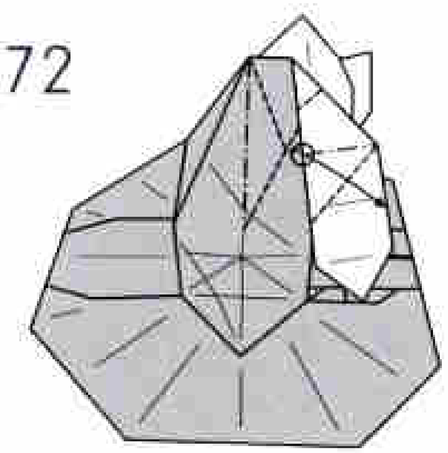
70



71



72



73
In progress.

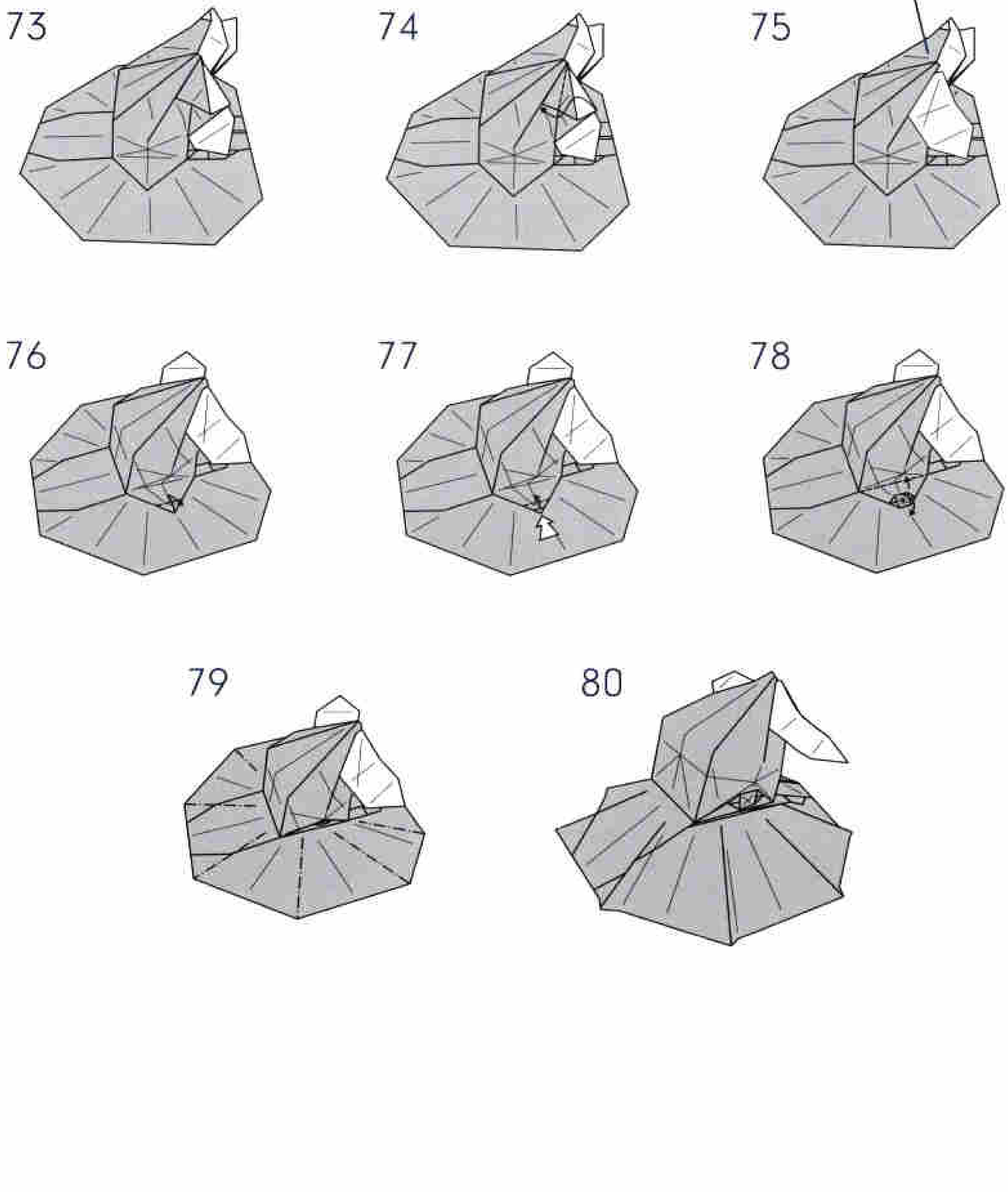
74
Tuck under.

75
Repeat steps 71 to 74 on the other side.

77
Squash.

79
Shape.

80
Dumbo octopus completed.





Marine Mammals

Orca

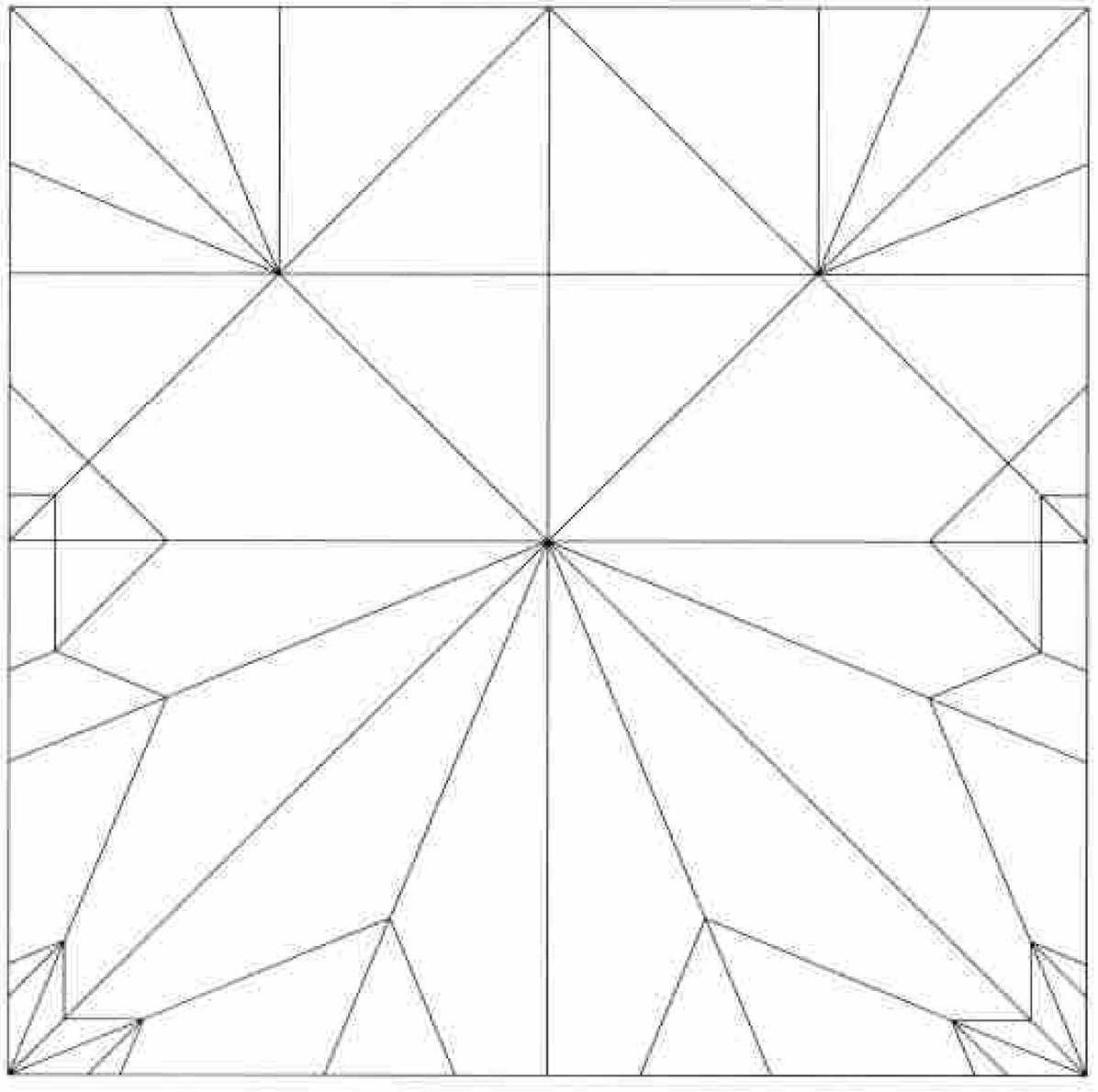
Beluga

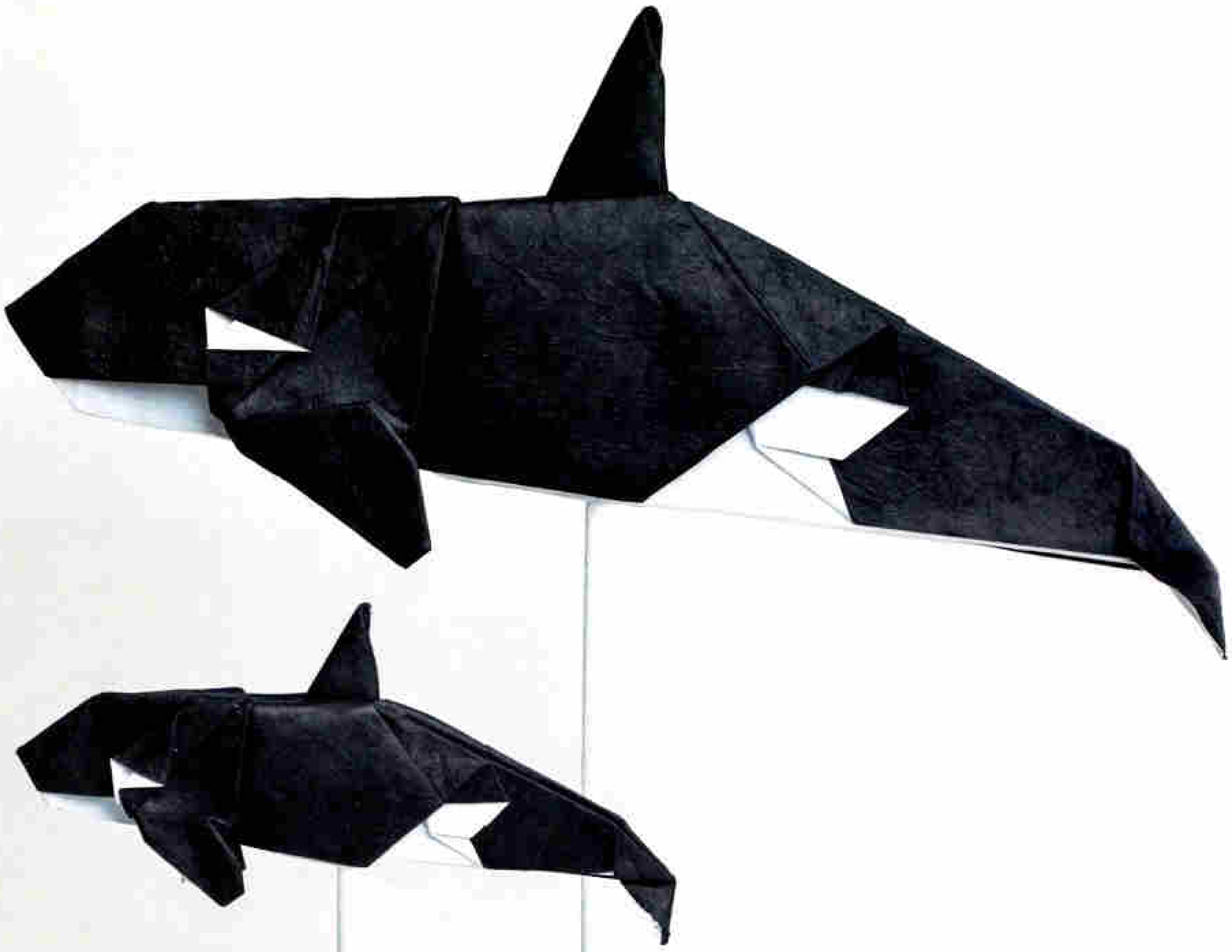
Sperm Whale

Sea Lion Pup

Orca

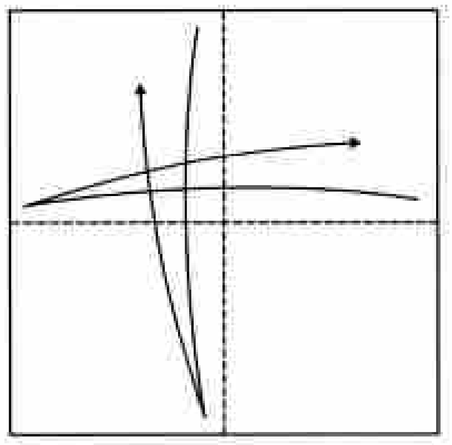
The apex predator in the ocean, the orca, is easily recognizable by its iconic patterning. The folds near the waist produce the belly spots of the whale. The tail layers are folded so that the underside remains white. One of the key elements of this design, as well as the beluga and sperm whale, is the design of the mid-to-tail section which brings together two corners of the paper.



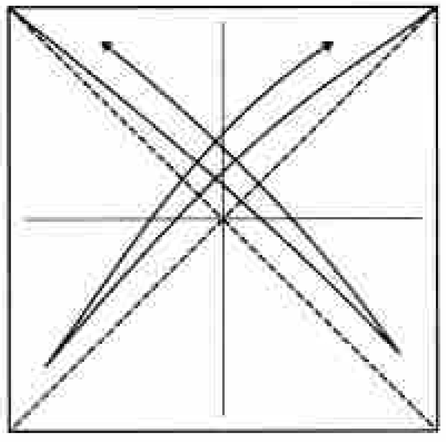


8
Inside reverse folds.

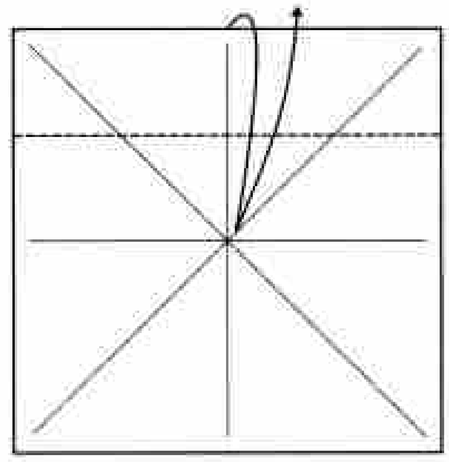
1



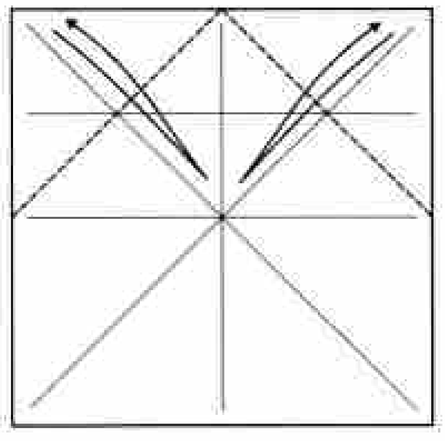
2



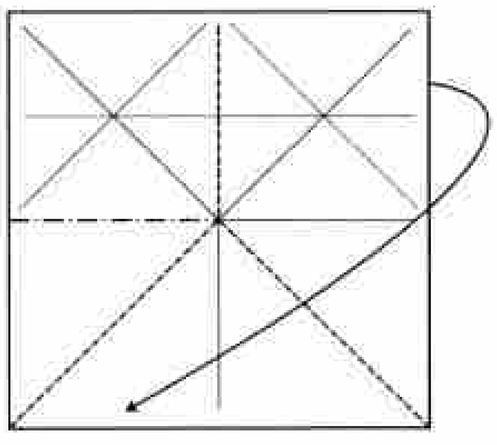
3



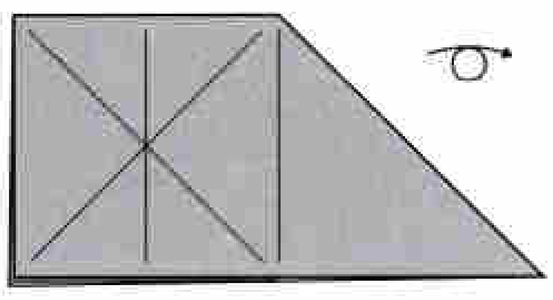
4



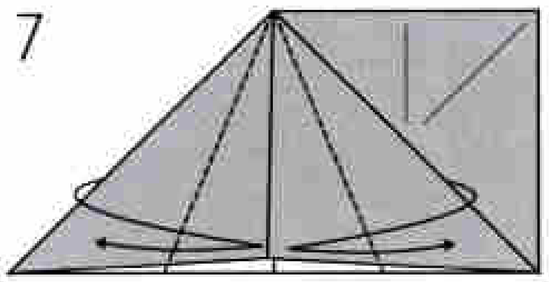
5



6



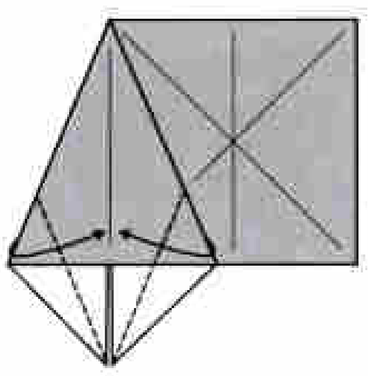
7



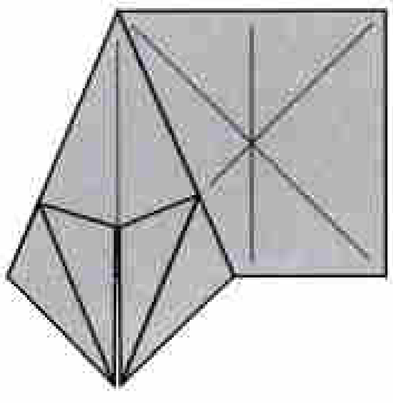
8



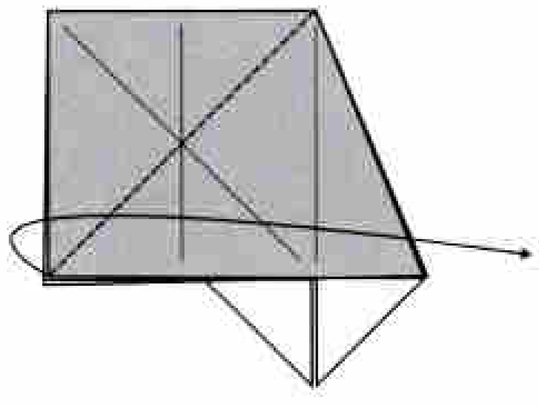
9



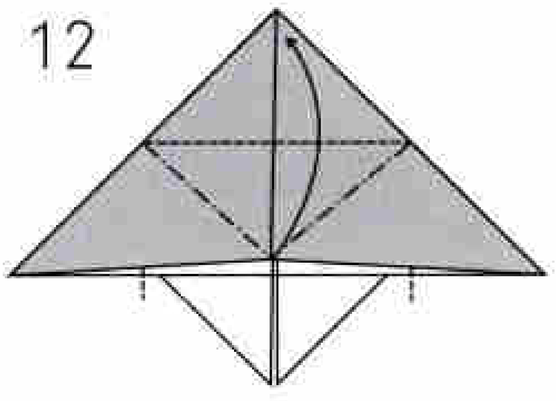
10



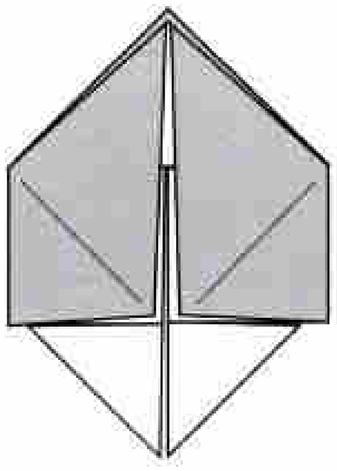
11



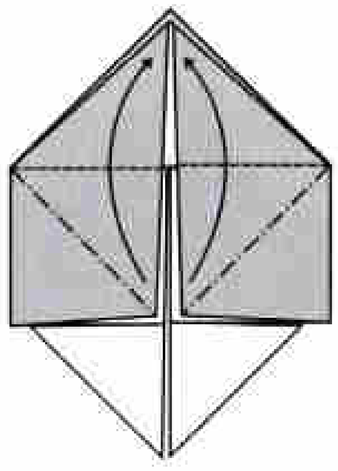
12



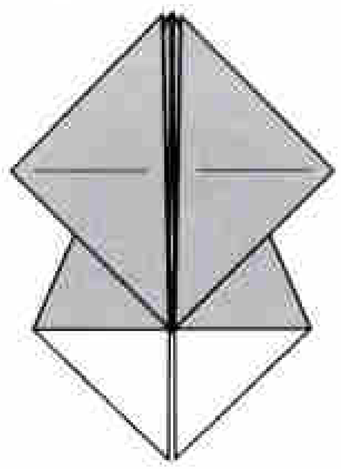
13



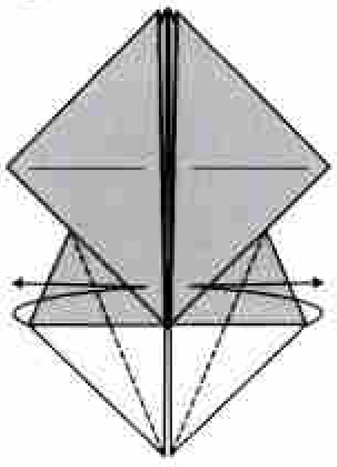
14



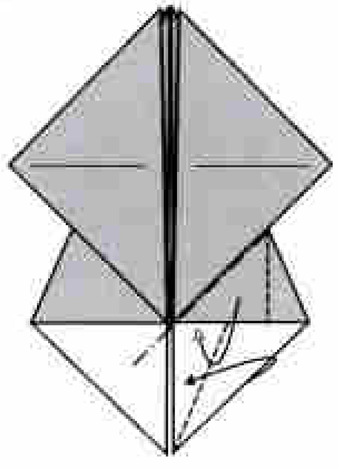
15



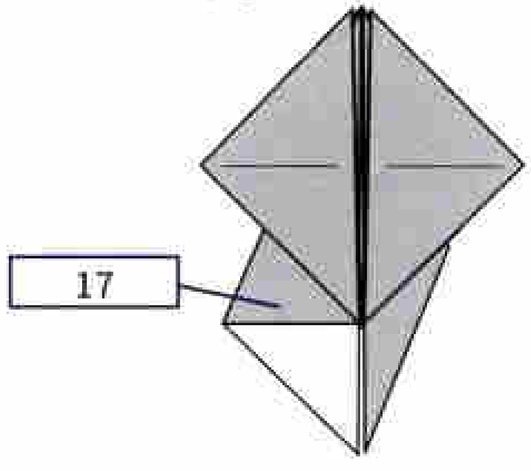
16



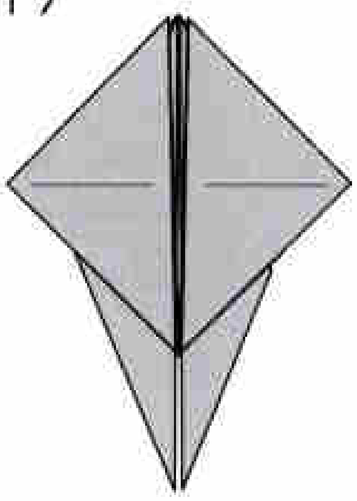
17



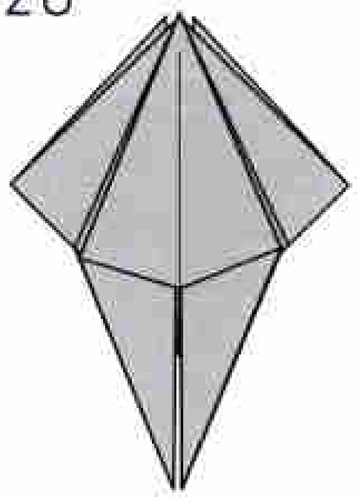
18



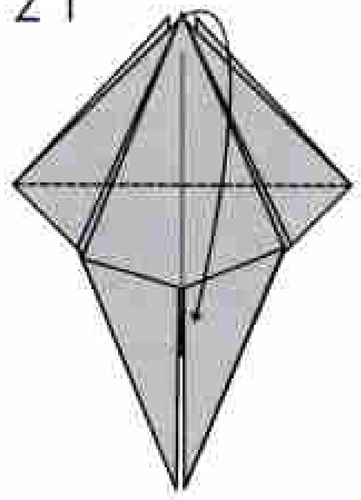
19



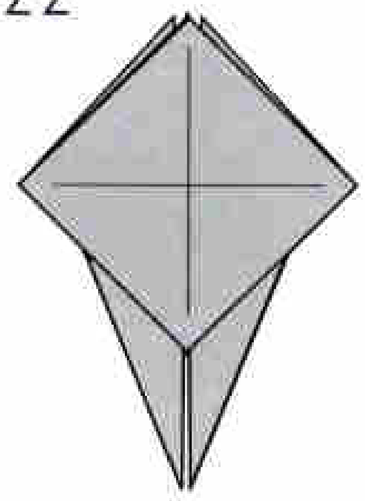
20



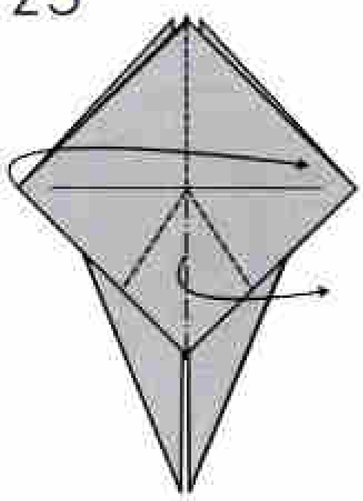
21



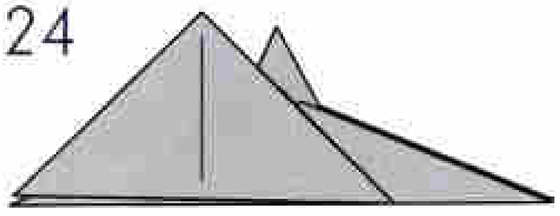
22



23



24



17
Inside reverse folds.

18
Repeat step 17 on the left side.

23
Valley fold the model and reverse fold the flap to create the dorsal fin.

24
Notice the angle of the fin.

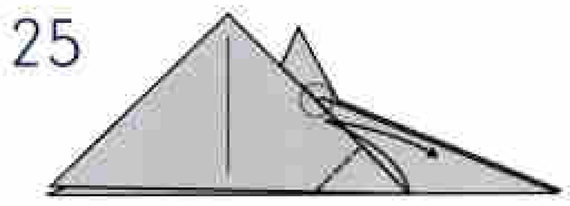
25
Fold and unfold.
Use reference
point.

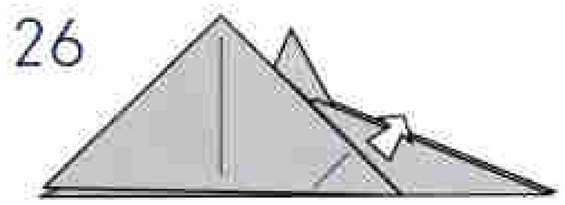
26
Pull out paper.

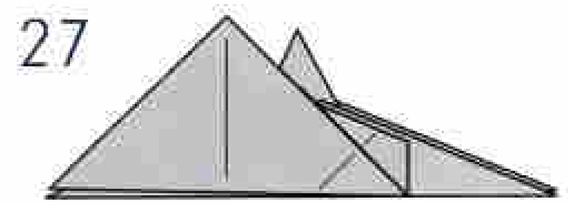
28
Fold and unfold.
Use reference
point.

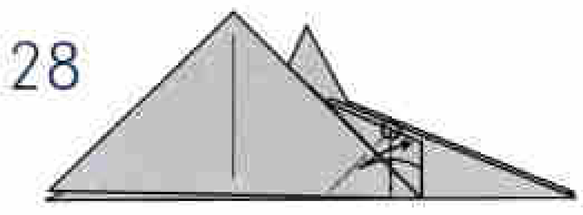
31
Crimp corner.
Repeat steps 25
to 31 behind.

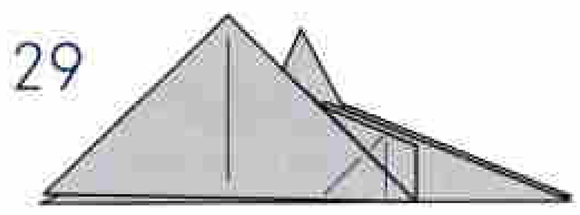
32
Crimp
completed.
Valley fold.

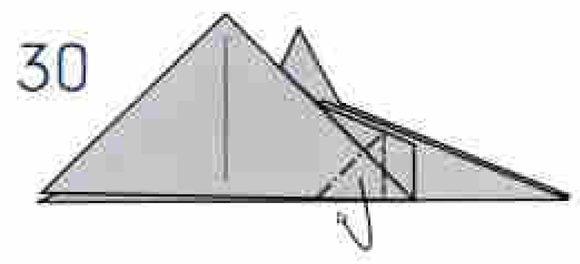




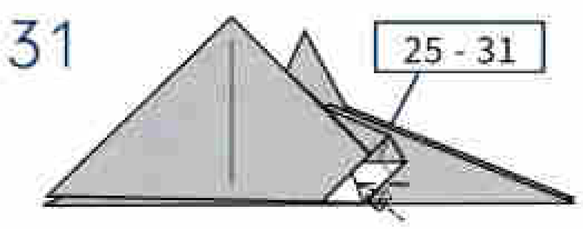


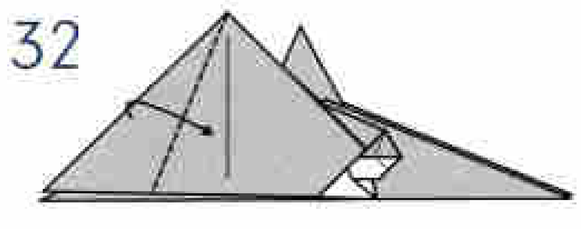


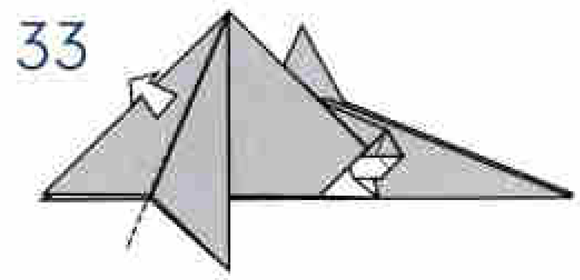


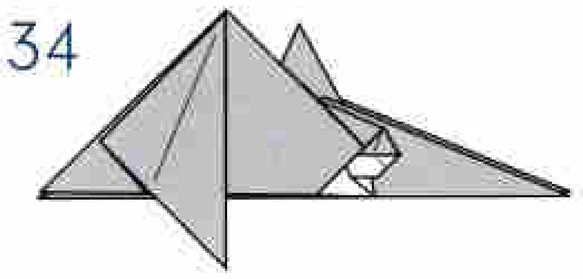


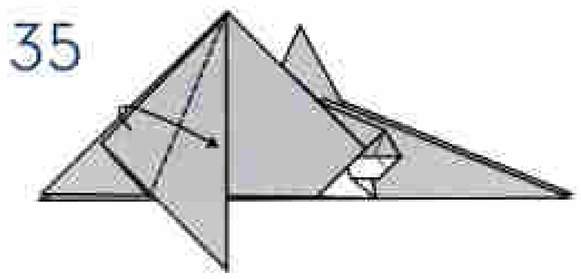
36
Repeat steps 32
to 35 behind.

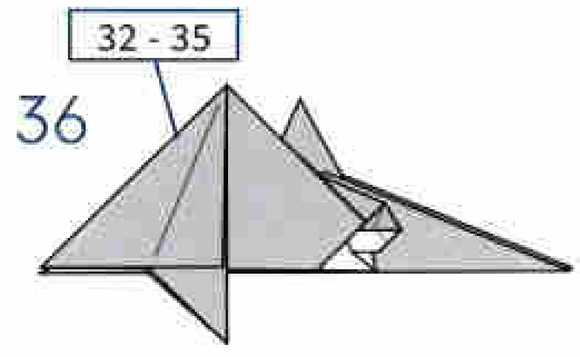












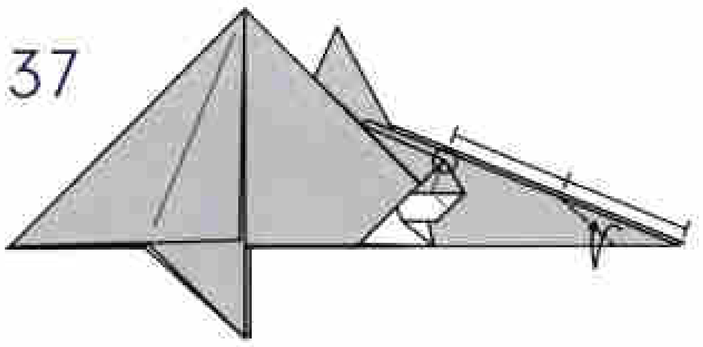
37
Fold and unfold.
Use references.

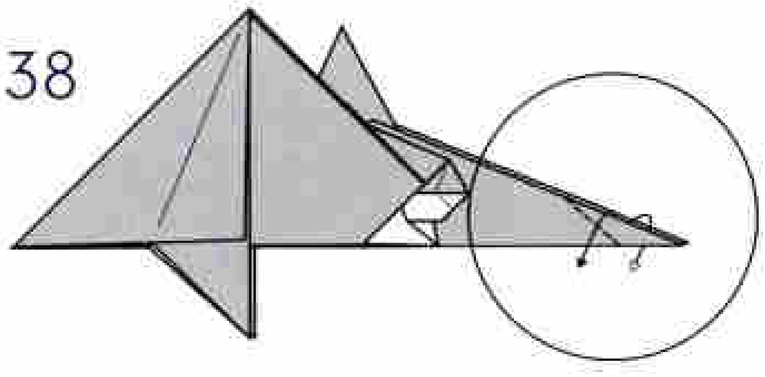
38
Outside reverse fold.

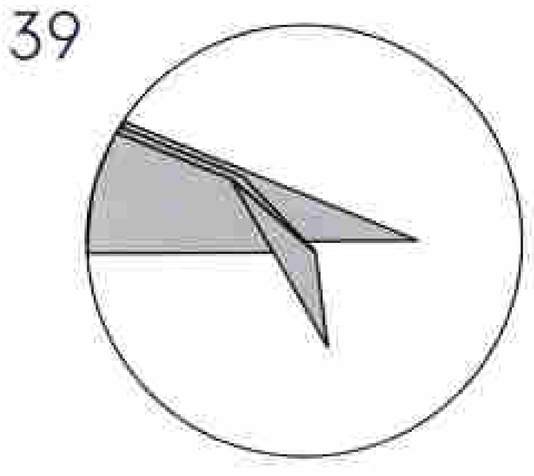
40
Pull out paper.

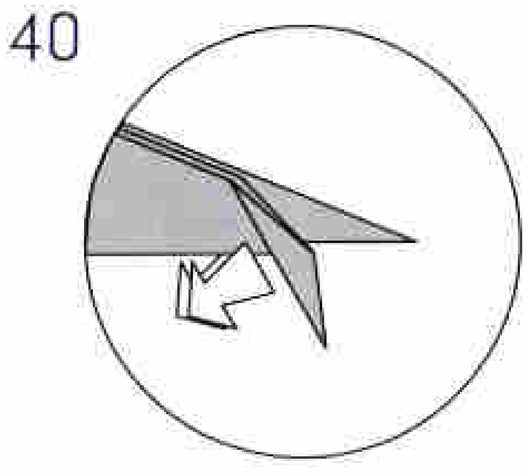
44
Repeat steps 38 to 43 on the other flap.

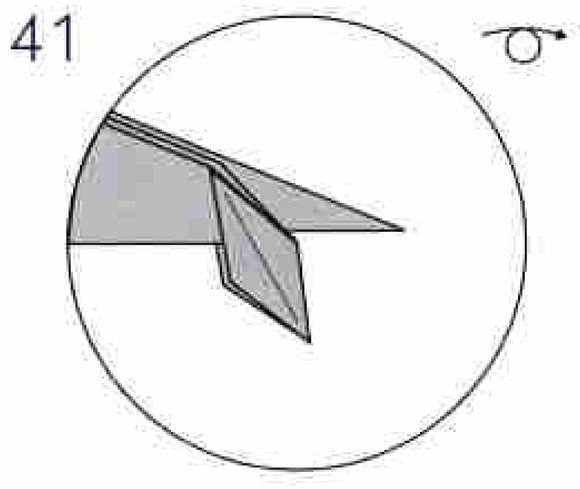
47
Mountain fold the corner.

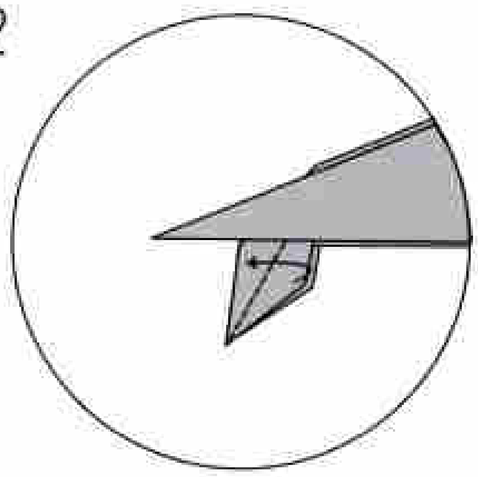


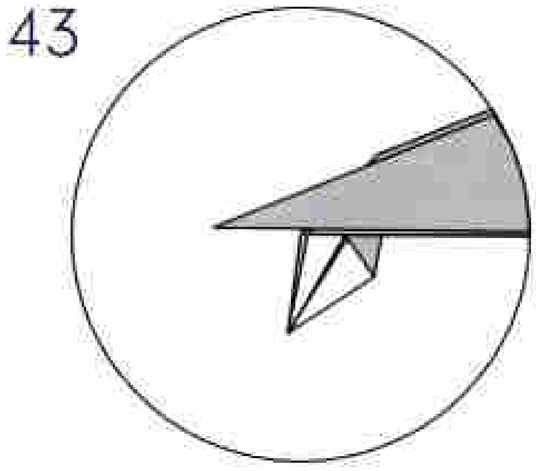


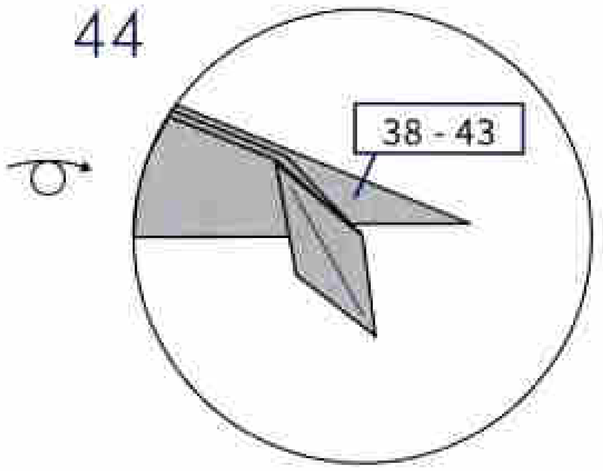


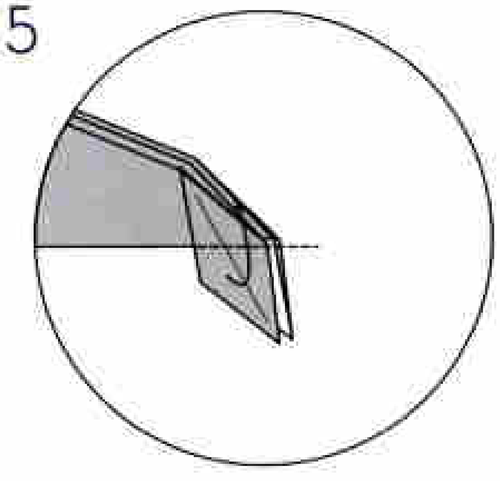


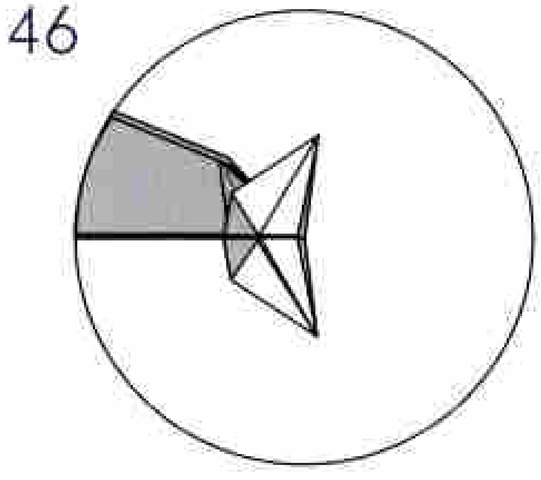


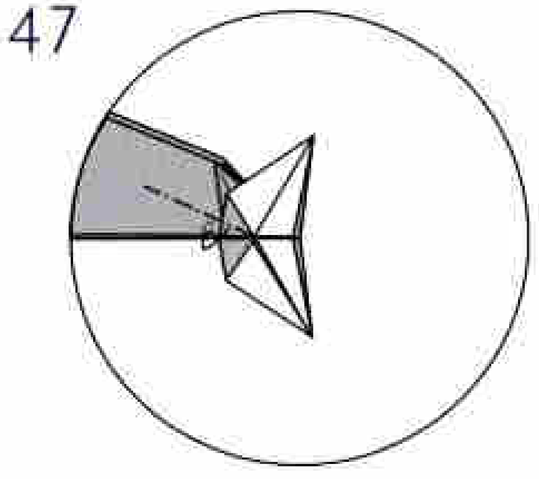








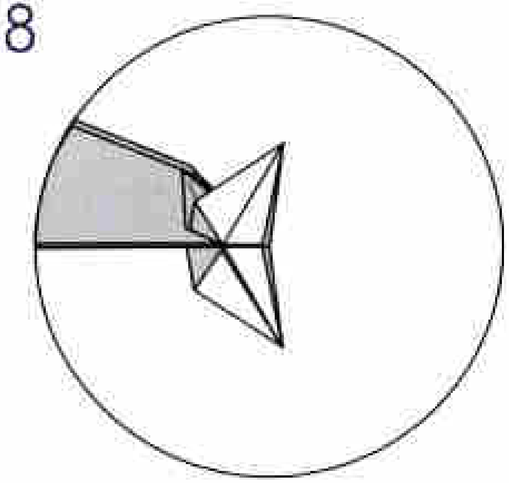




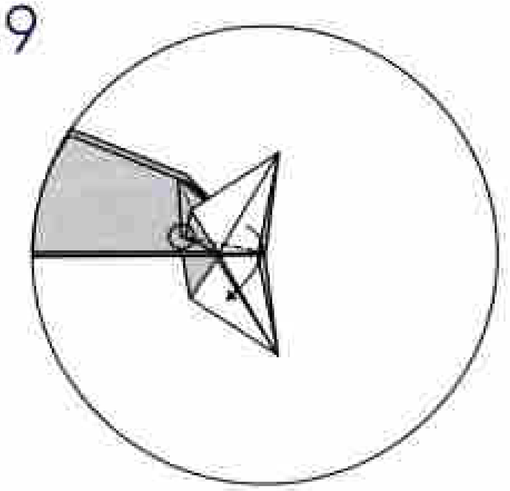
50
Repeat steps 45 to 49 behind.

54
Repeat behind.

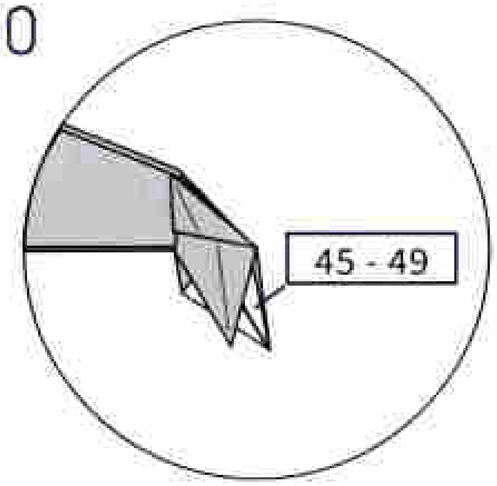
48



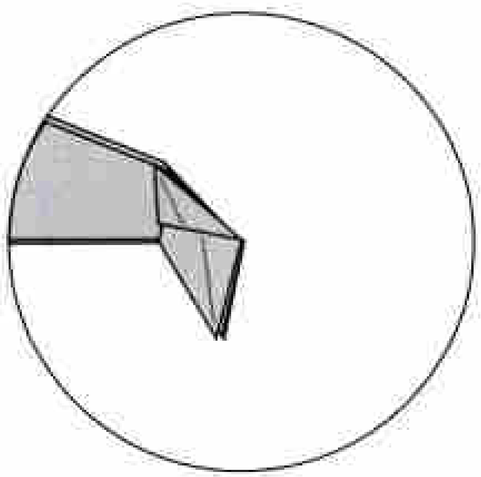
49



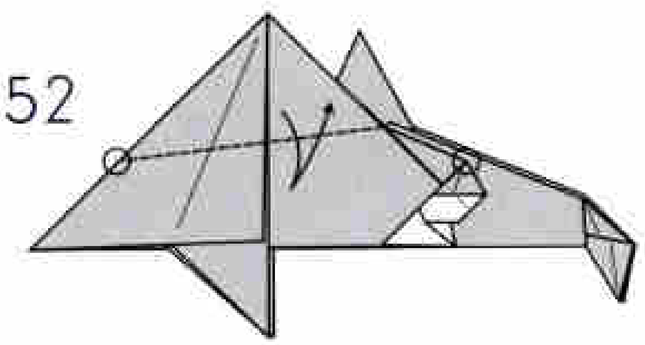
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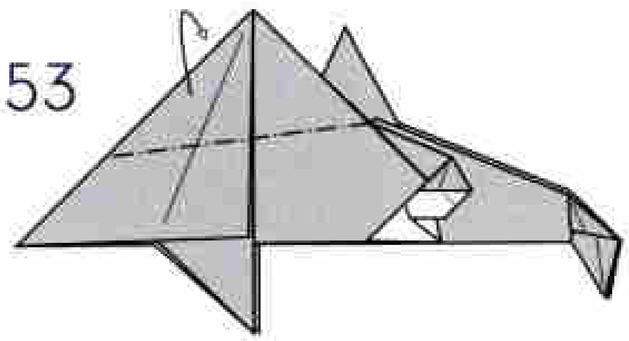
51



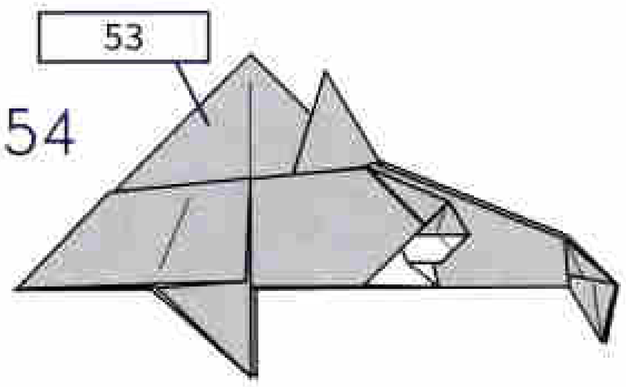
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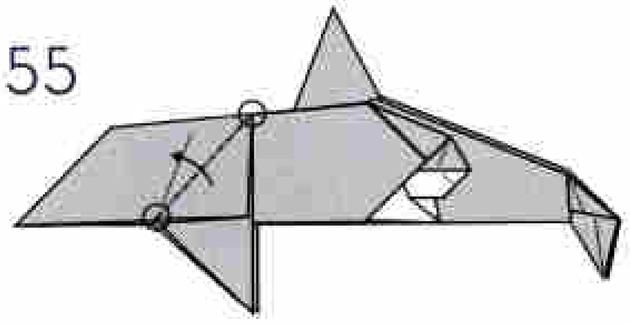
53



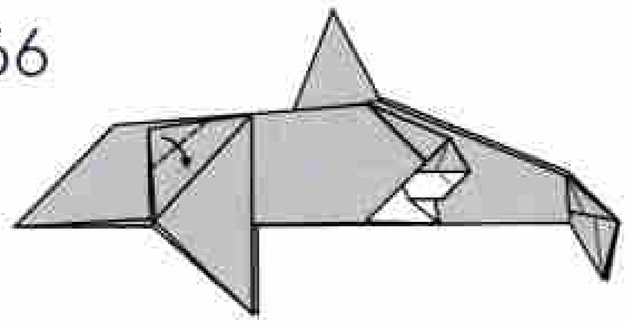
54



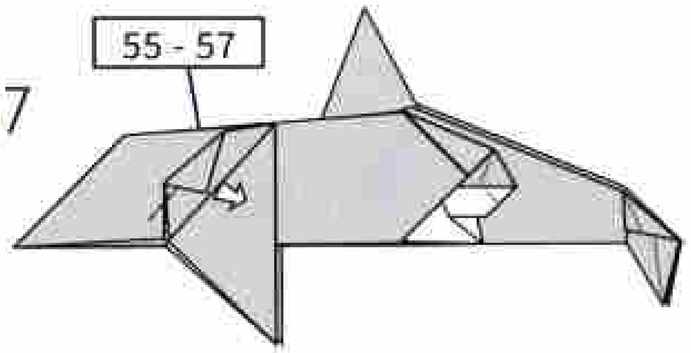
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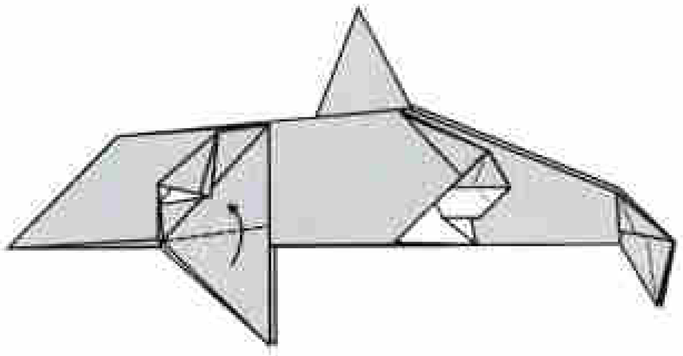
56



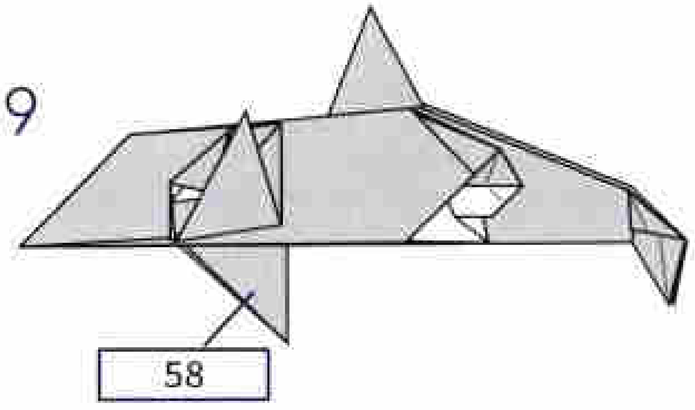
57



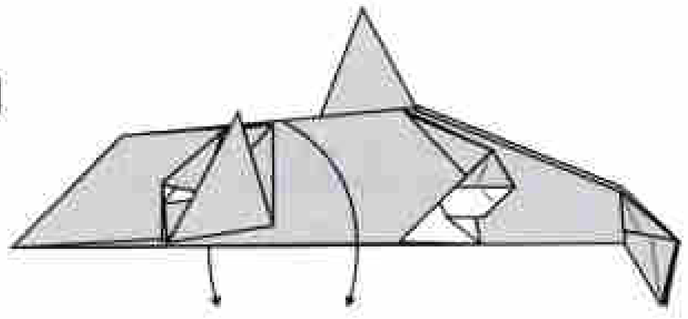
58



59



60



57
Shift out paper.
Repeat steps 55
to 57 behind.

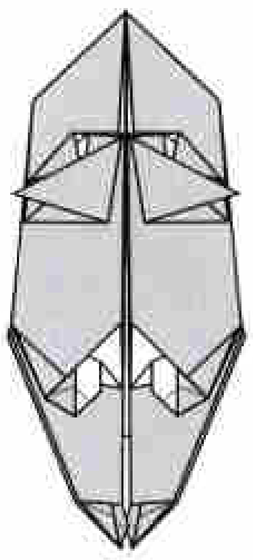
59
Repeat behind.

60
Open model.

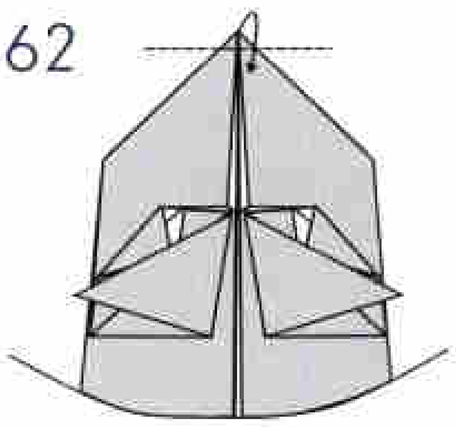
63
Mountain folds
at a slight
angle.

64
Mountain folds
completed.
Close model.

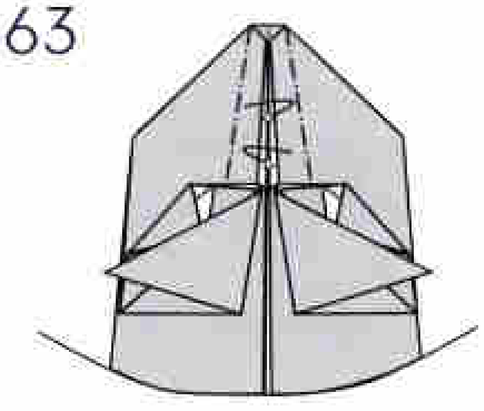
61



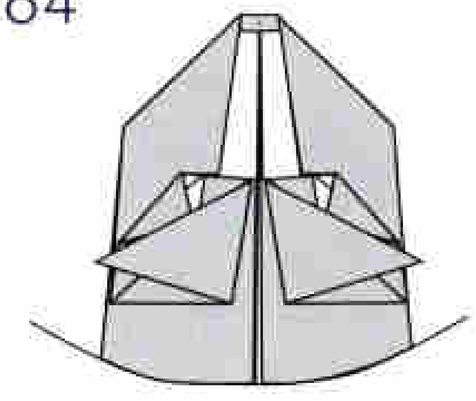
62



63



64



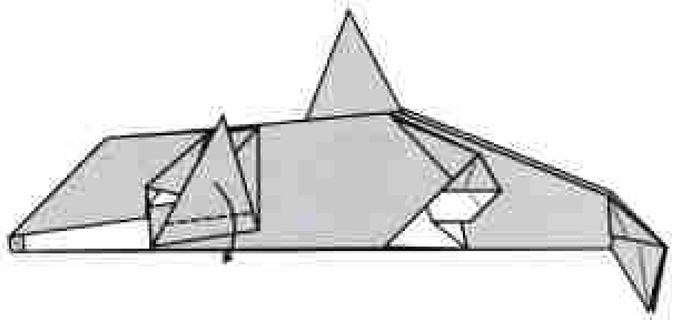
66
Inside reverse folds.

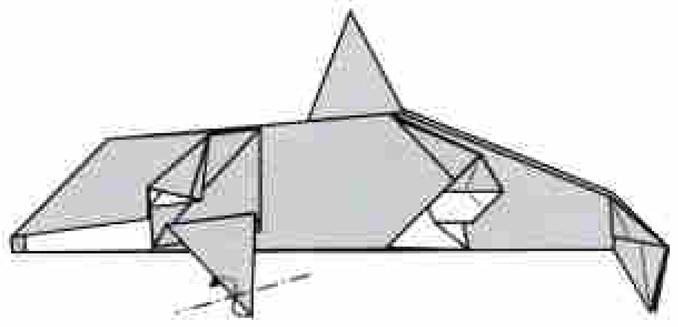
67
Inside reverse folds.

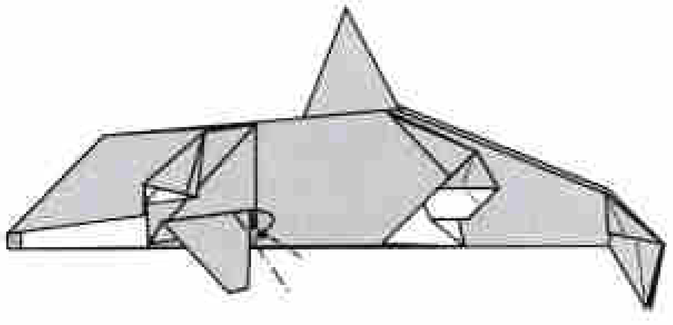
68
Mountain fold corner. Repeat steps 65 to 68 behind.

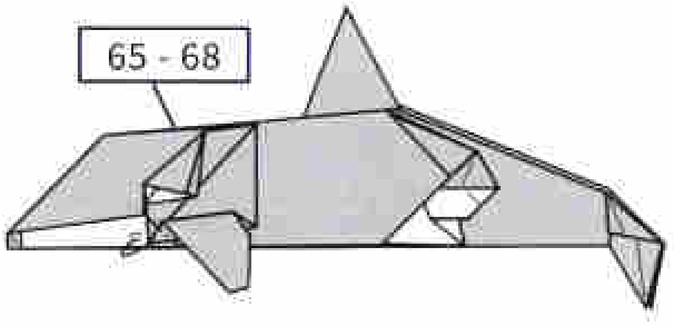
70
Repeat step 69 behind.

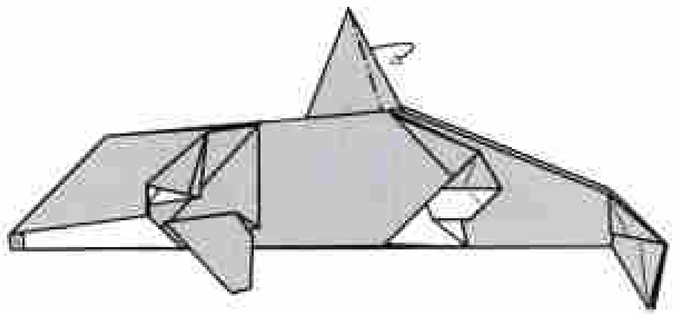
72
Inside reverse fold.

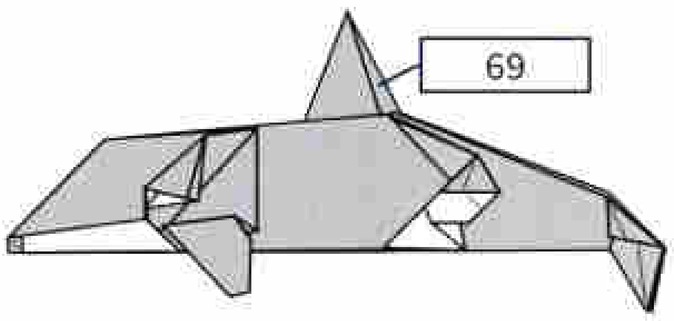
65


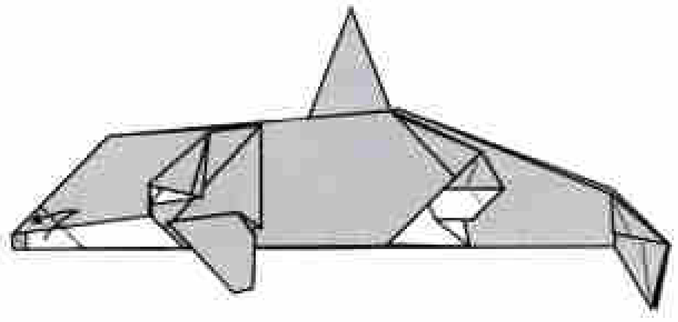
66


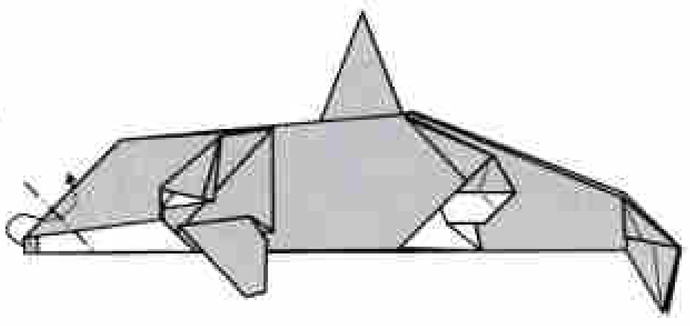
67


68


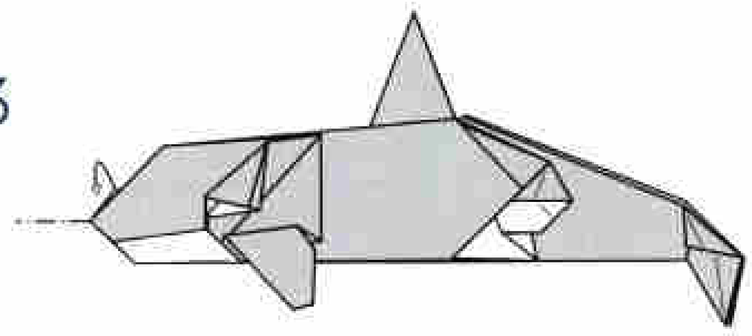
69


70


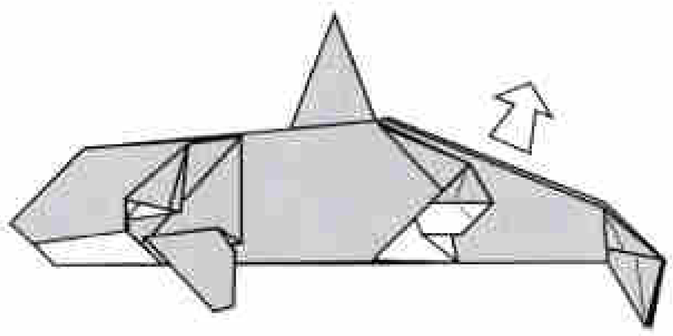
71


72


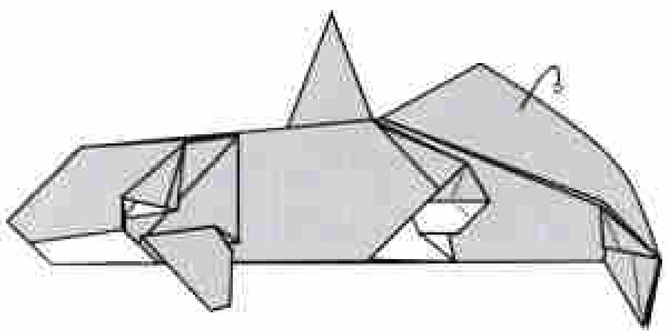
73



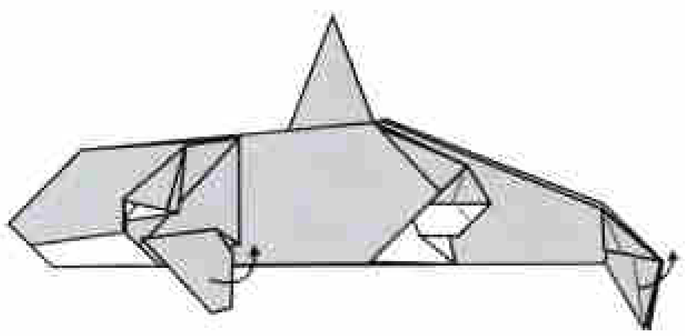
74



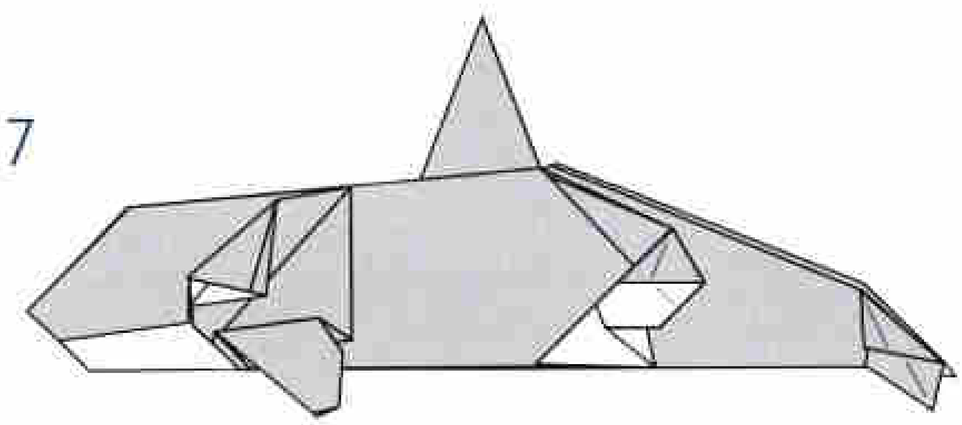
75



76



77



73
Mountain fold the flap in step 72 to lock head.

74
Pull out one of the flaps.

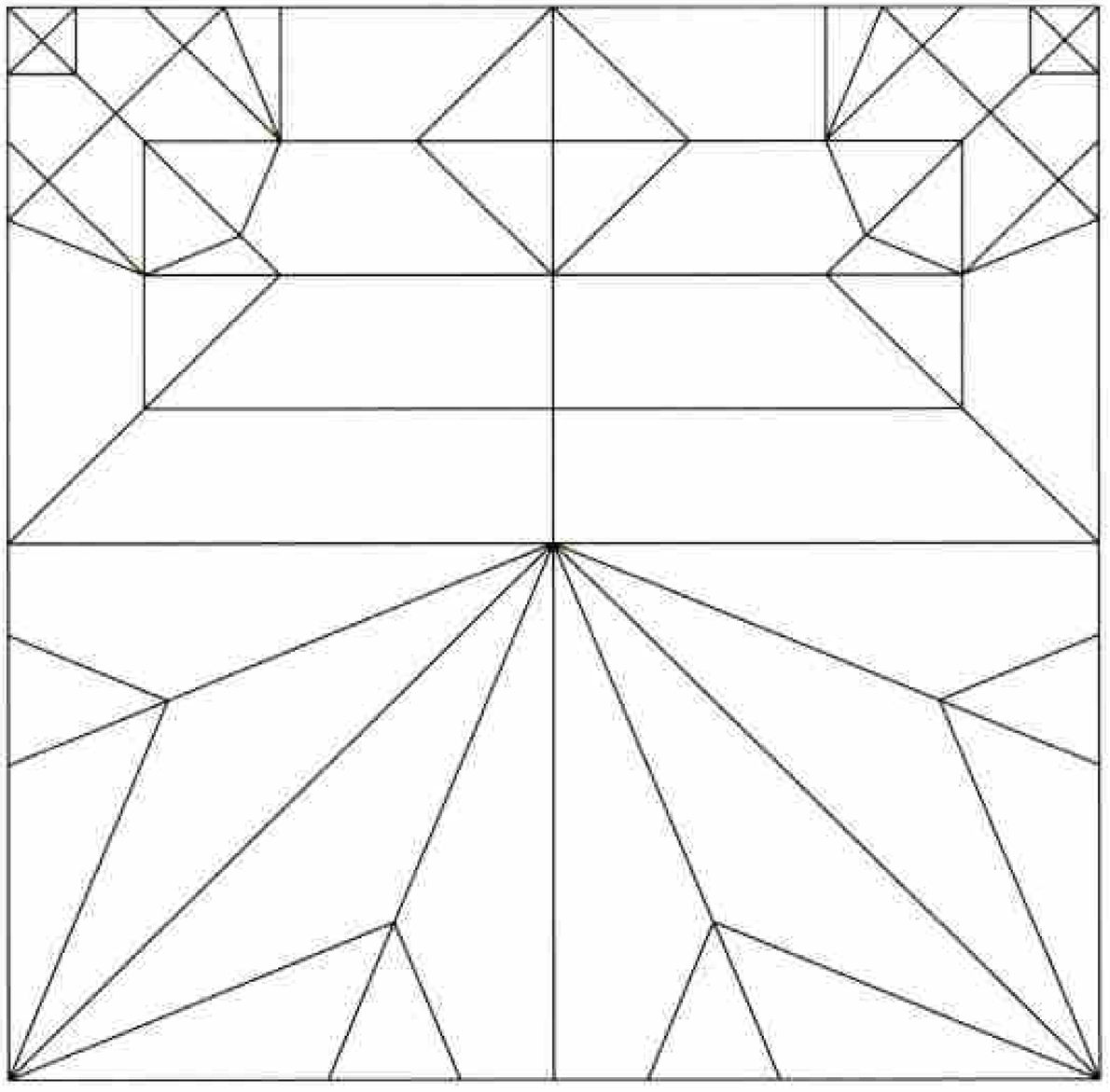
75
Insert into the pocket on the other side to lock the tail.

76
Shape.

77
Orca completed.

Beluga

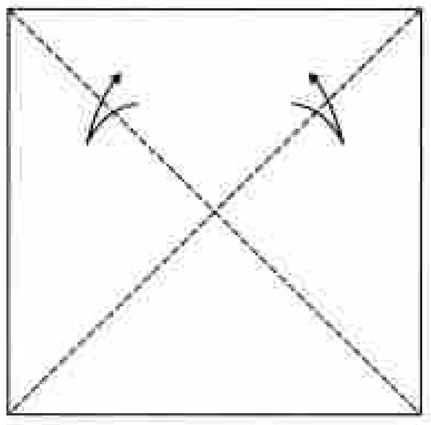
The goal of this model was to create a new whale design in the style of the orca. The beluga uses the same starting ratio and basic structure for the tail. The corners of the flaps are squashed to form the sides of the tail, and the two flaps are locked together using a flap and pocket method. In sea life origami, I try to make the models "hydrodynamic" by limiting forward-facing gaps as much as possible. However, this is not always possible or practical for all features in a design, such as the flippers in this specific model.



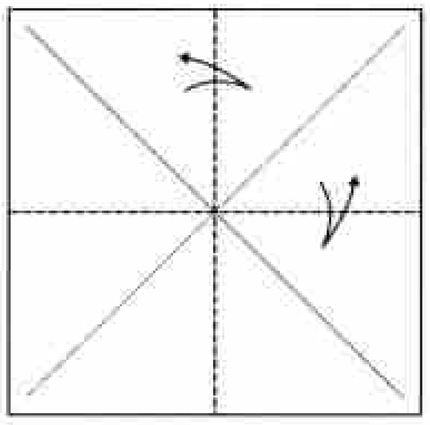


10
Collapse.

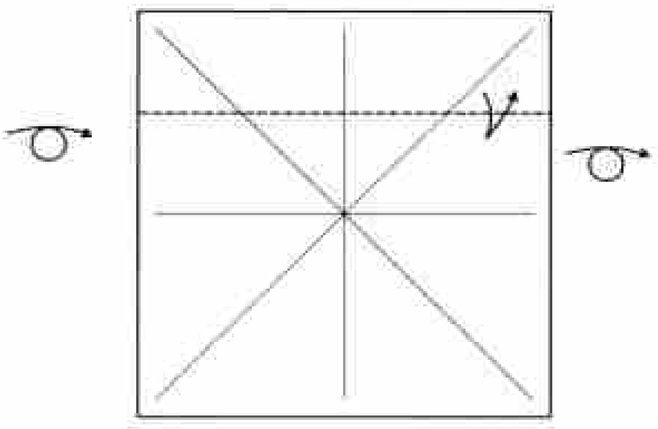
1



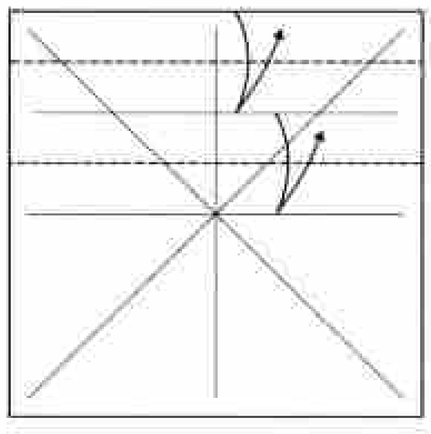
2



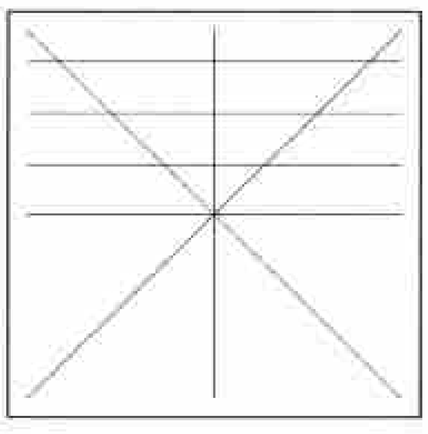
3



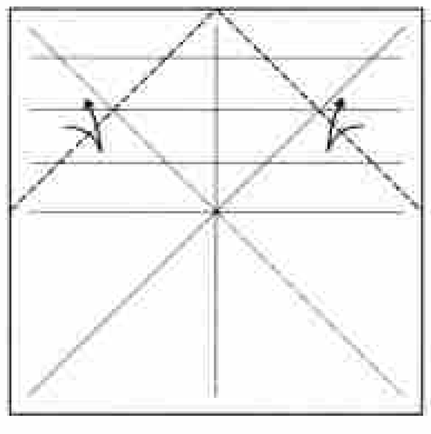
4



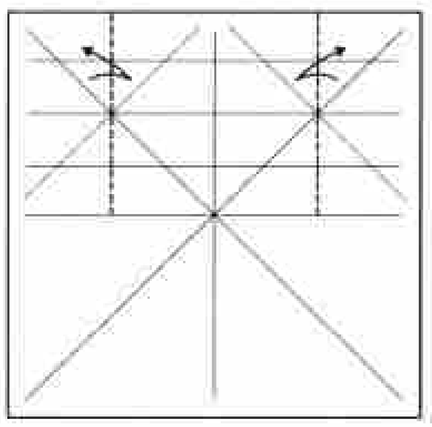
5



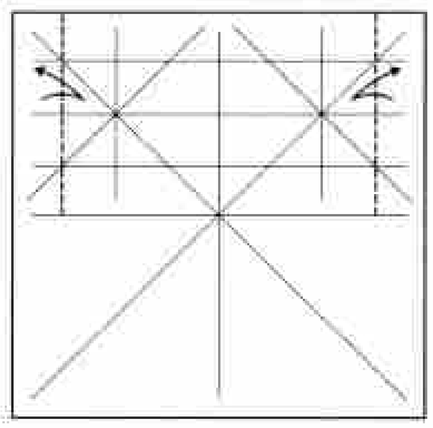
6



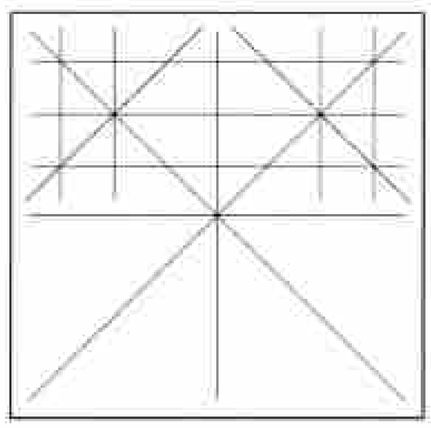
7



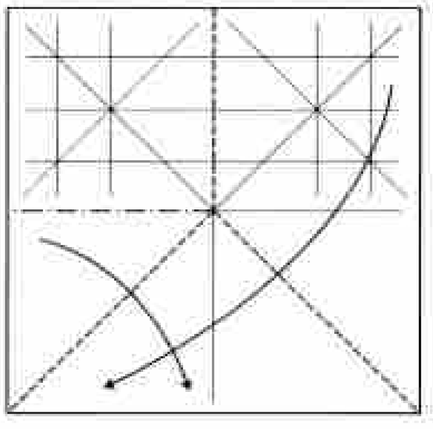
8



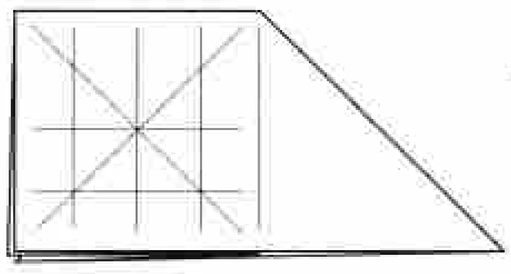
9



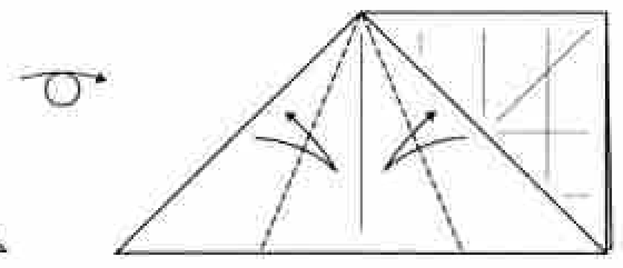
10



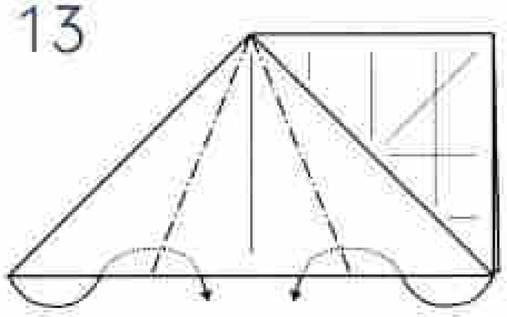
11



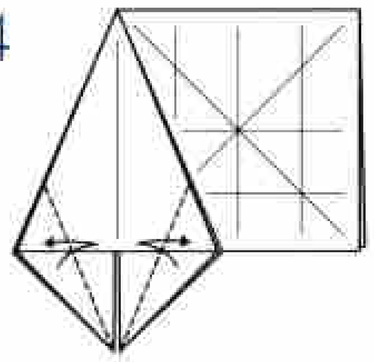
12



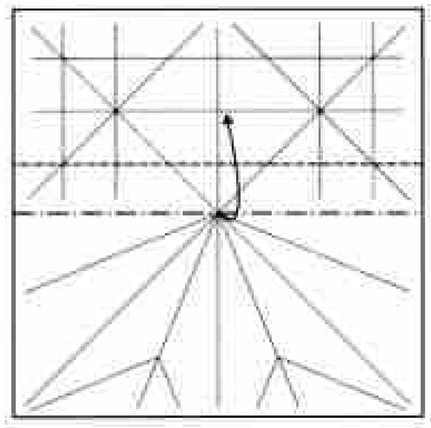
13



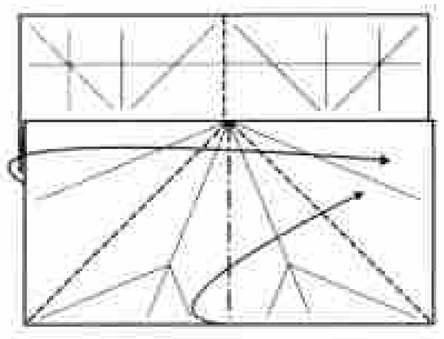
14



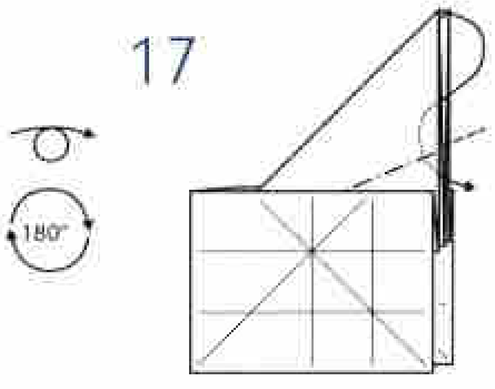
15



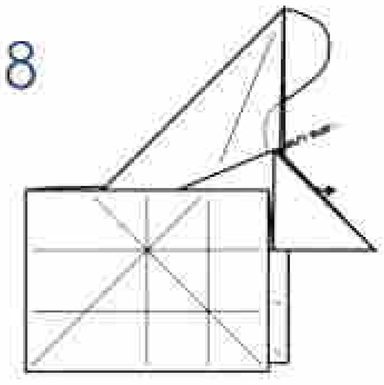
16



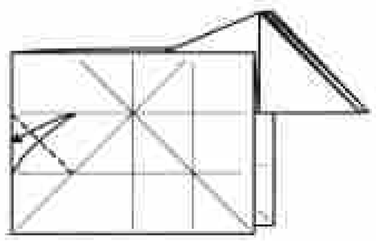
17



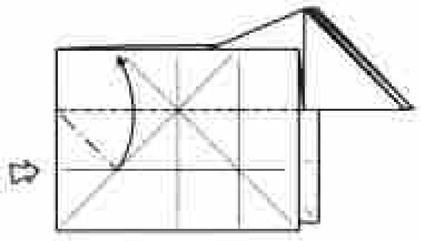
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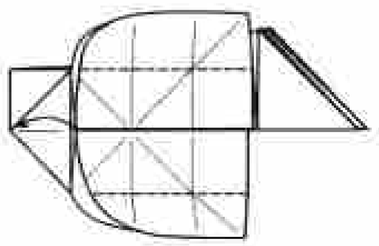
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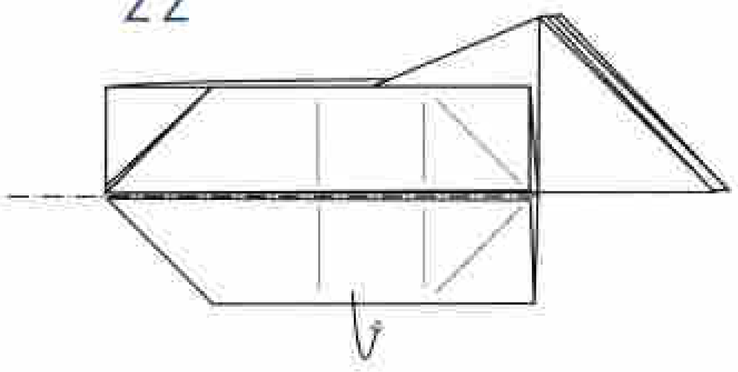
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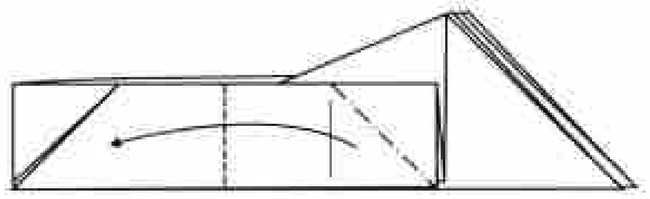
21



22



23



13
Inside reverse folds.

14
Fold and unfold. Unfold every-thing.

15
Pleat.

16
Collapse.

17
Inside reverse fold.

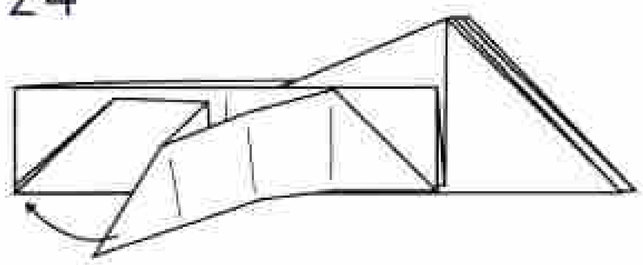
18
Inside reverse fold.

25
Valley fold and tuck behind. Repeat steps 23 to 25 behind.

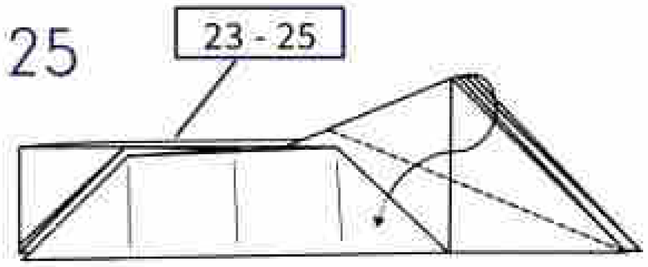
30
Swivel the flipper while folding the angle bisector.

31
Unfold.

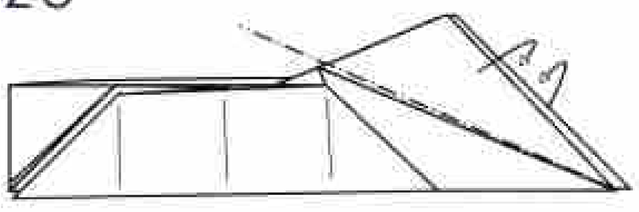
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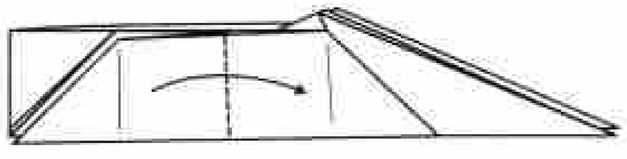
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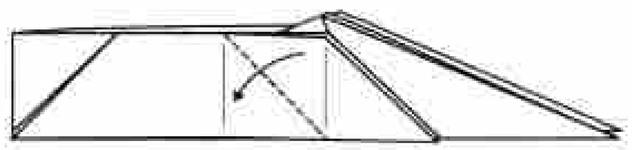
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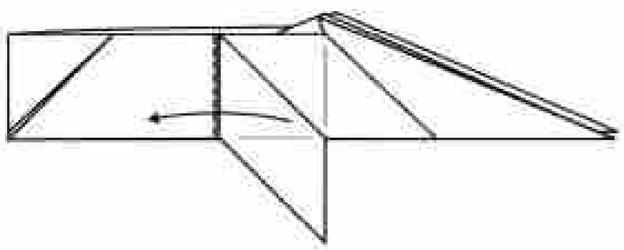
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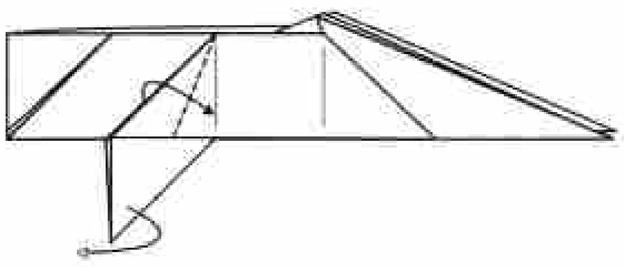
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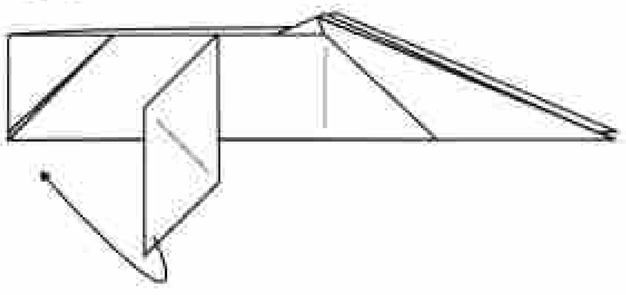
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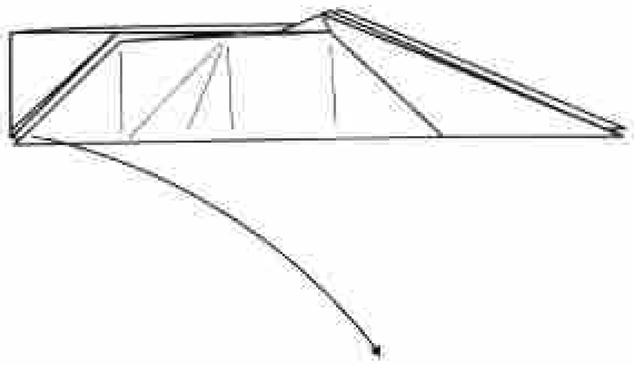
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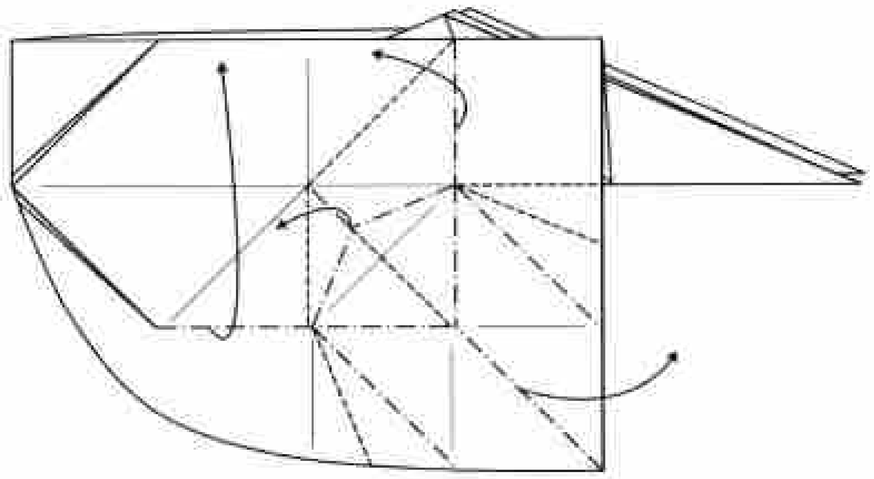
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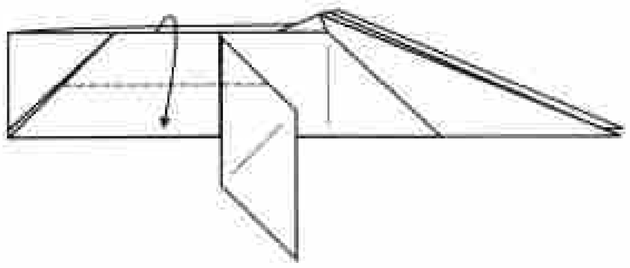
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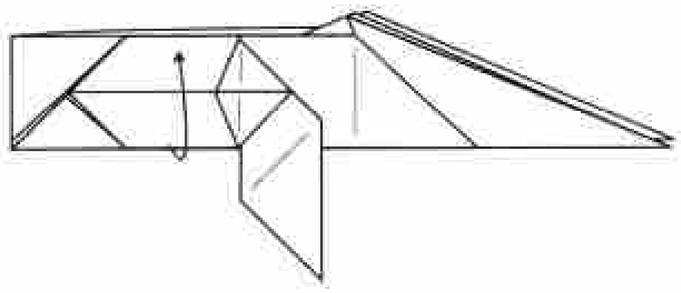
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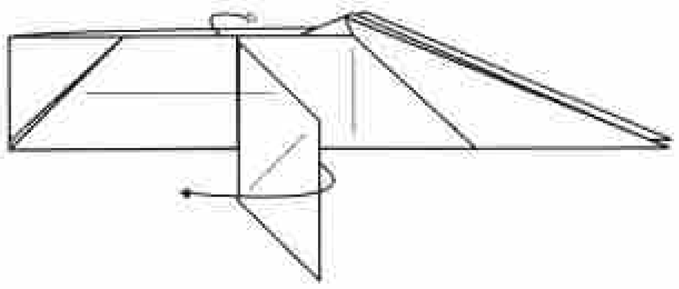
34



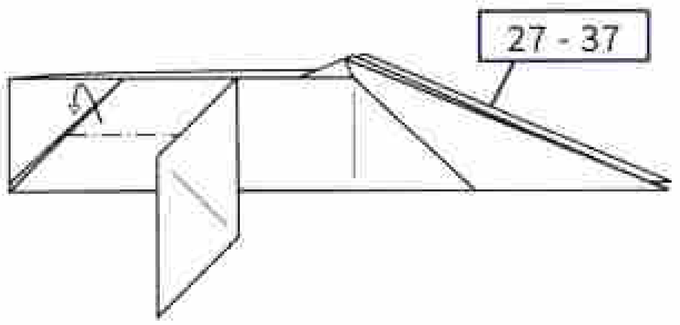
35



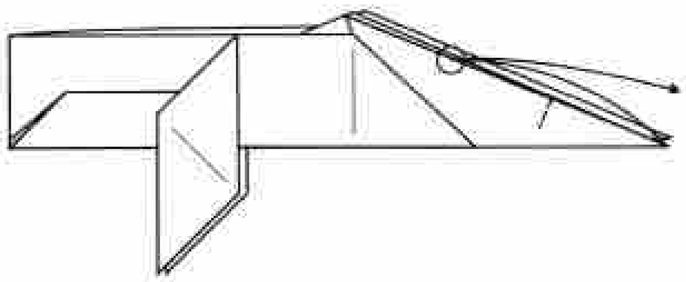
36



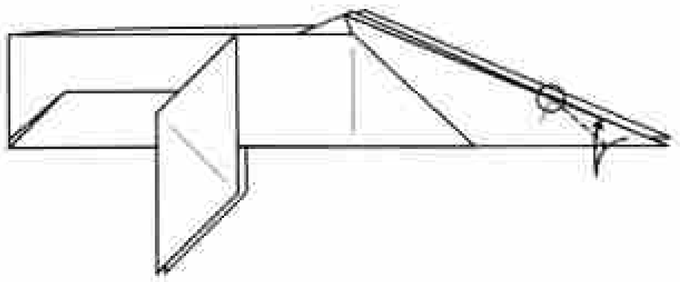
37



38



39



32
Open.

33
Collapse.

36
Fold the flipper forward while swiveling the flap behind.

37
Mountain fold. Repeat steps 27 to 37 behind.

38
Fold and unfold to the point.

39
Fold and unfold. Use the reference point.

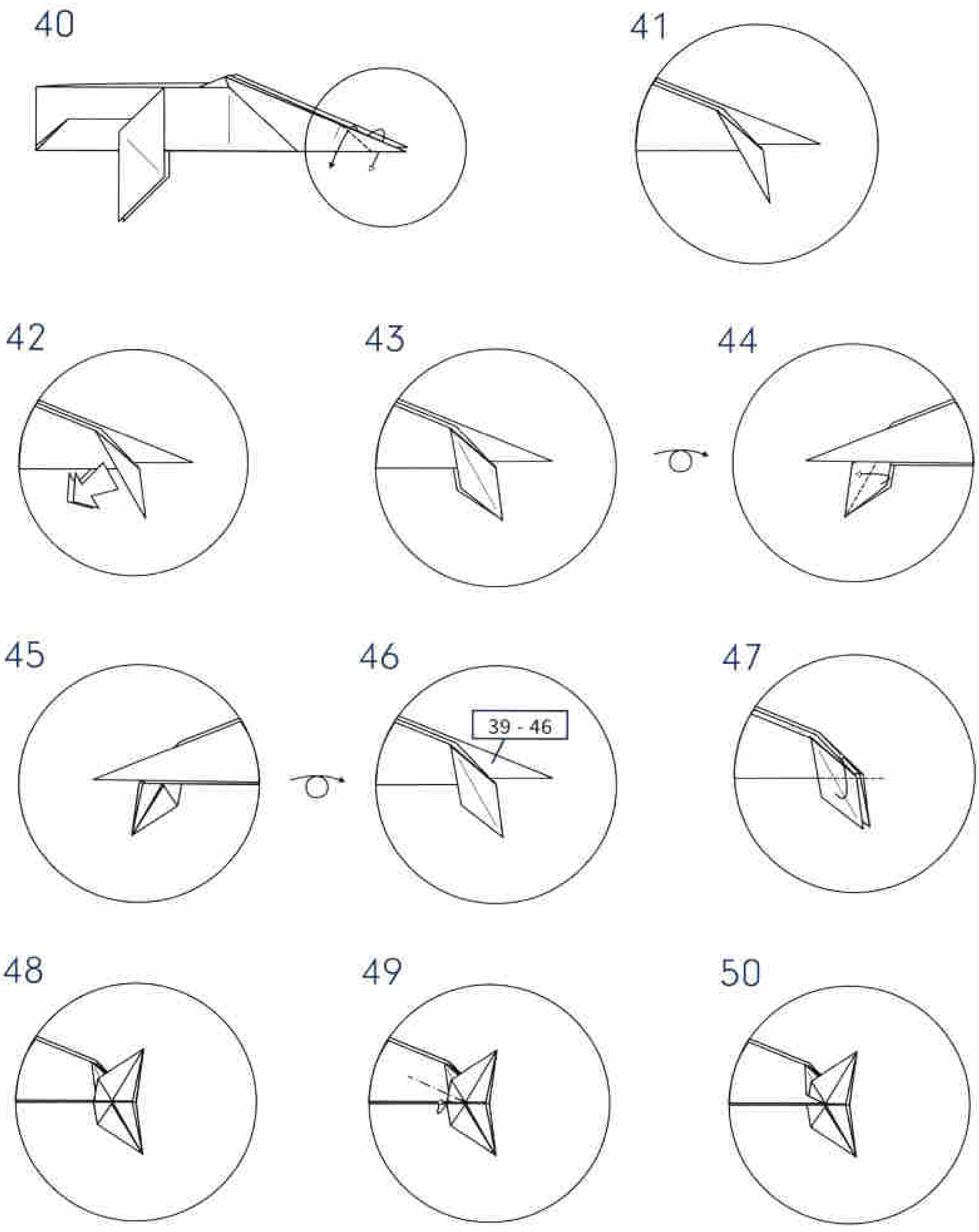
40
Outside reverse fold.

42
Pull out paper from inside.

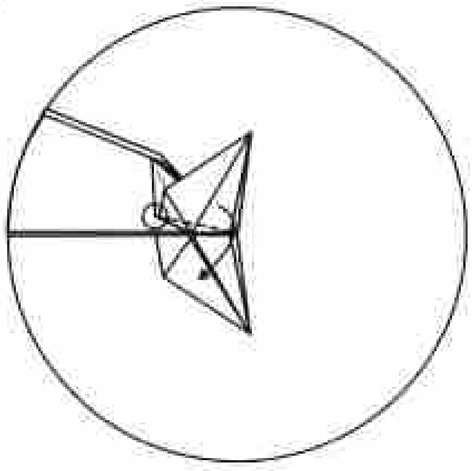
44
Valley fold.

46
Repeat steps 39 to 46 behind.

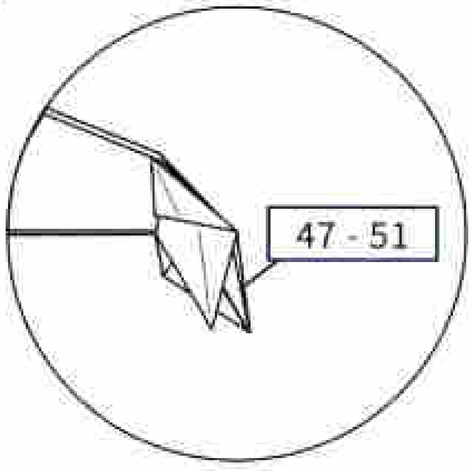
49
Mountain fold the corner.



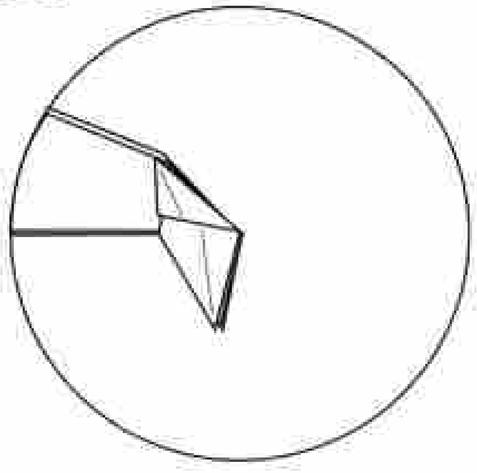
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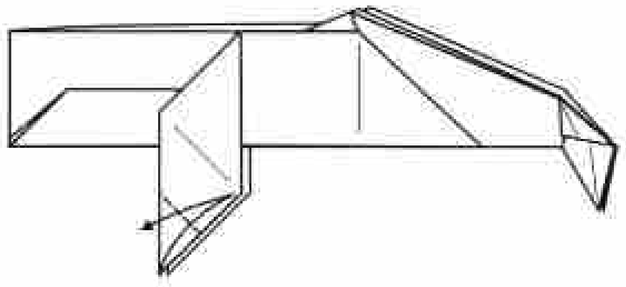
52



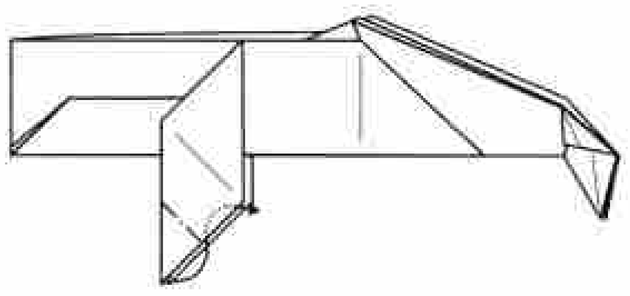
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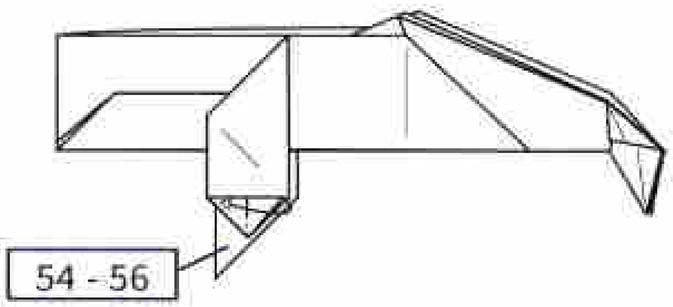
54



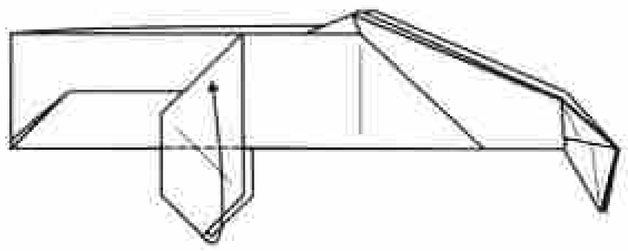
55



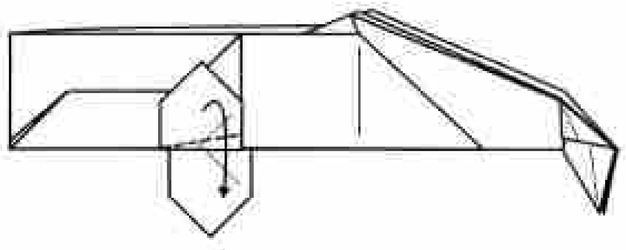
56



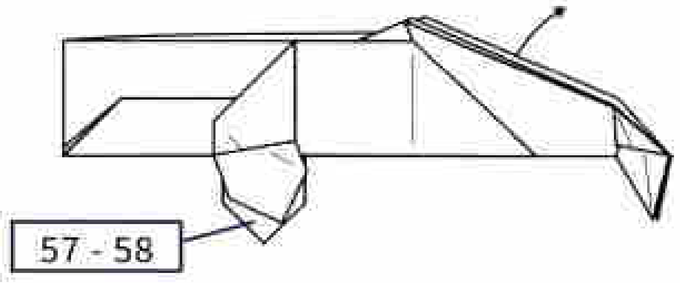
57



58



59



52
Repeat steps 47 to 51 behind.

55
Inside reverse fold.

56
Mountain fold the inner flap to lock. Repeat steps 54 to 56 behind.

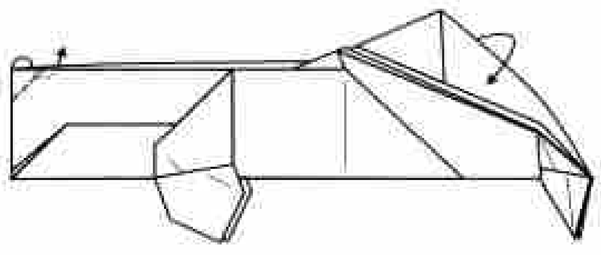
59
Repeat steps 57 and 58 behind. Pull out one of the flaps.

60
Wrap over the other flap to lock. Inside reverse fold the corner of the head flap.

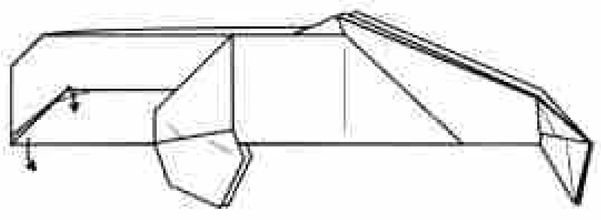
61
Shape.

62
Beluga completed.

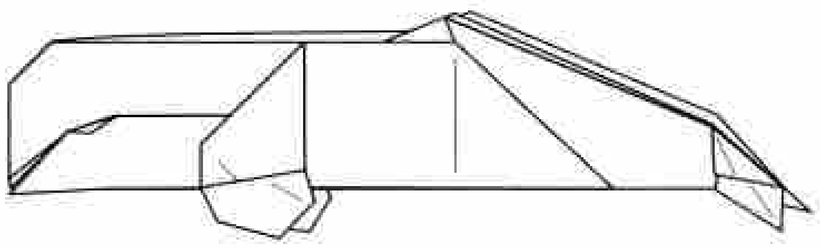
60



61



62



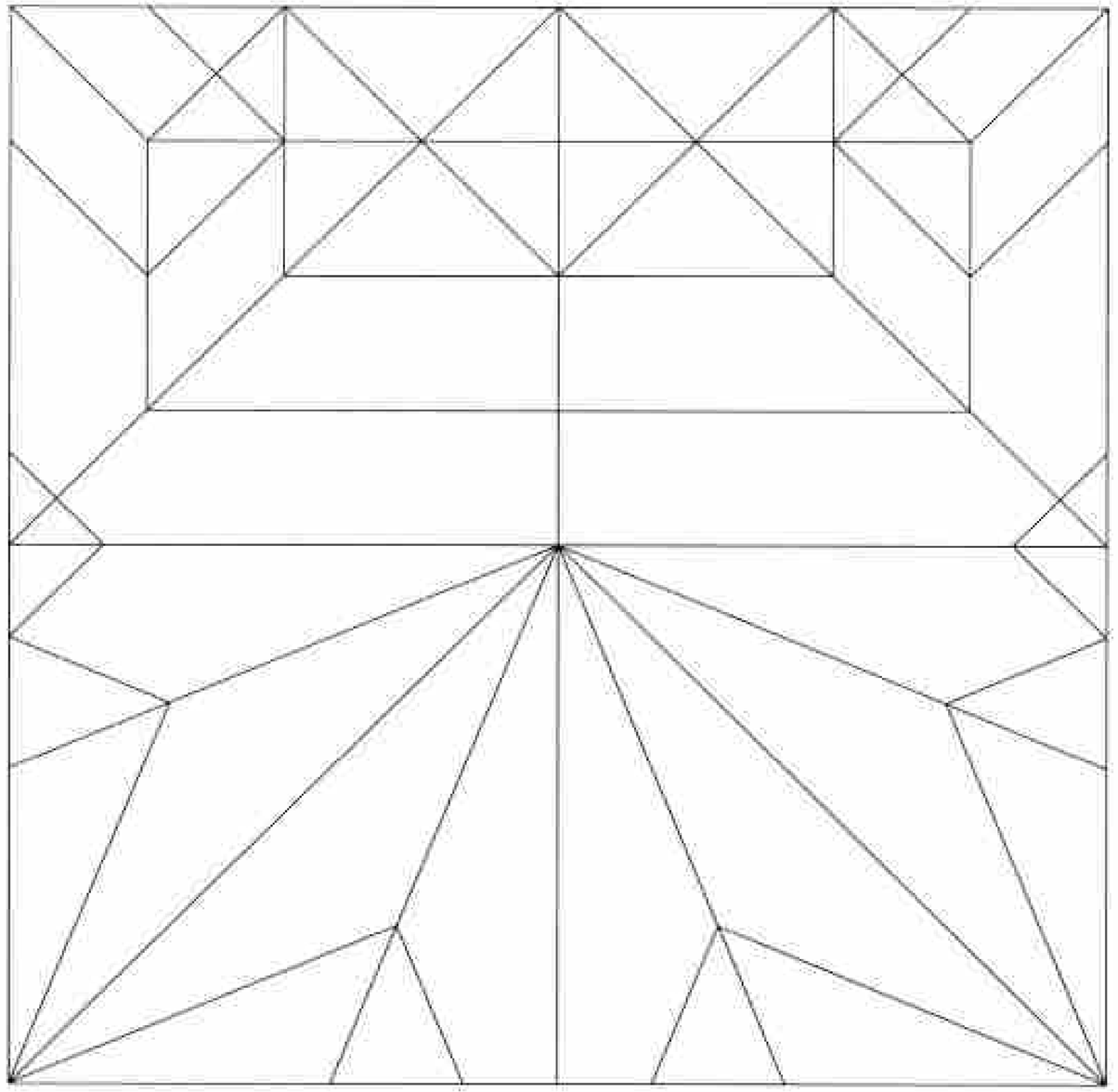
On Locks

Models can lose their shaping over time due to the inherent weakness of paper. Locks can help prevent this loss of shaping. Additional uses include holding specific poses, keeping flaps tucked in, and closing exposed areas of the structure. Most of the models in this book utilize at least one locking mechanism. For some, it is an integral part of the structural design. One example is the squid, which uses a flap and pocket method to lock the cone.

Designing locks can be fairly easy. Oftentimes they can be discovered by reconfiguring existing flaps or layers. You can turn one side of a model into a flap and the other into a pocket such as in the orca design. Having a familiarity with modular origami can be helpful because you can apply modular locking structures in figurative design.

Sperm Whale

What makes the sperm whale distinctive is its enormous rectangular head. To capture this rectangular look, I minimized the number of visible layers around the head area by hiding them inside. This required a challenging sinking maneuver. A small difference between this model and the beluga is the flap covering the back half. In the sperm whale, I decided to place it over the body layer to create a larger visible back section.

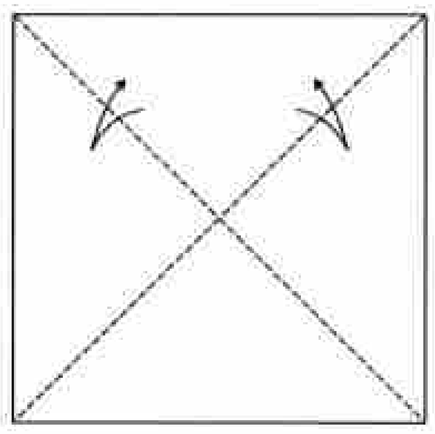




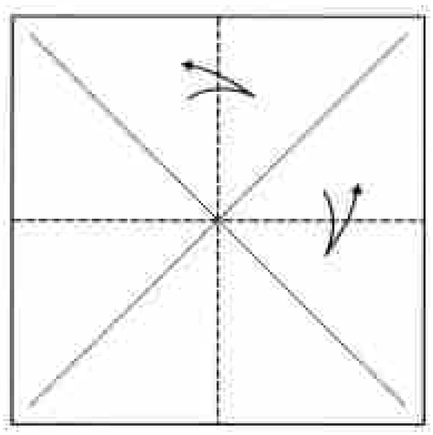


10
Collapse.

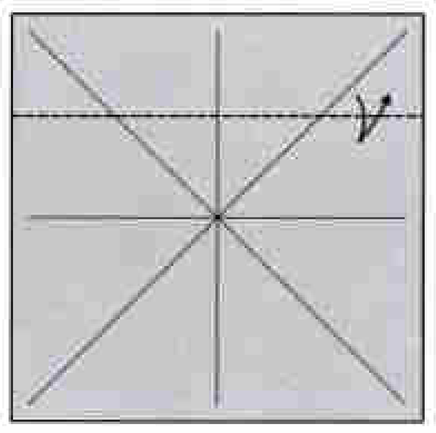
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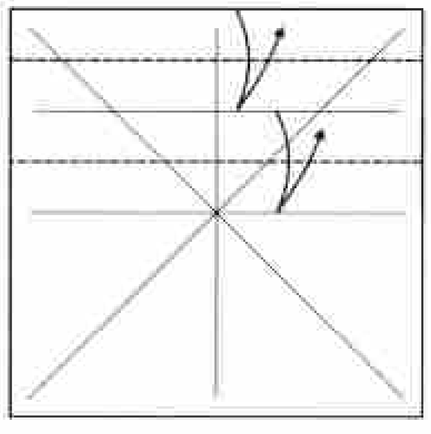
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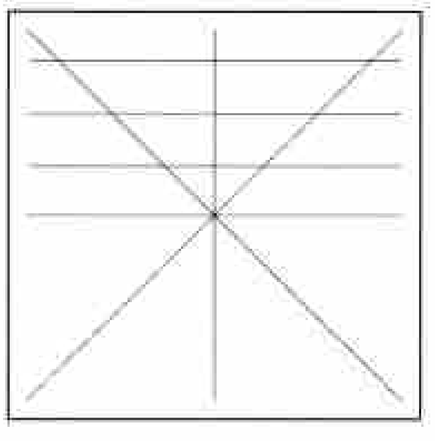
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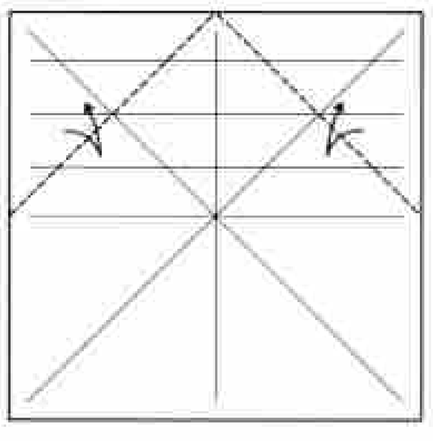
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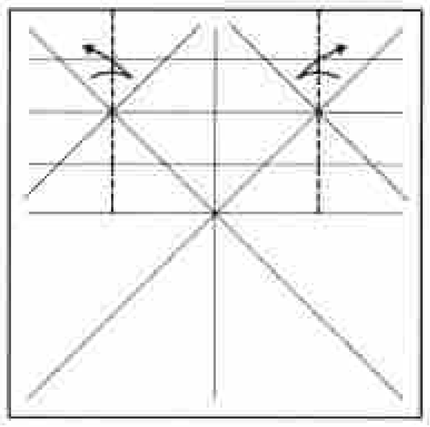
5



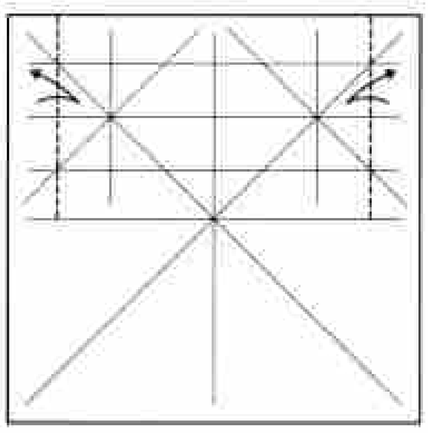
6



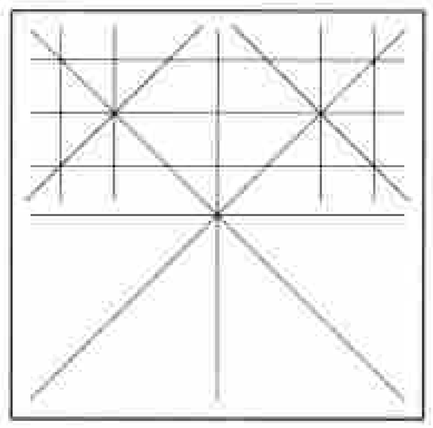
7



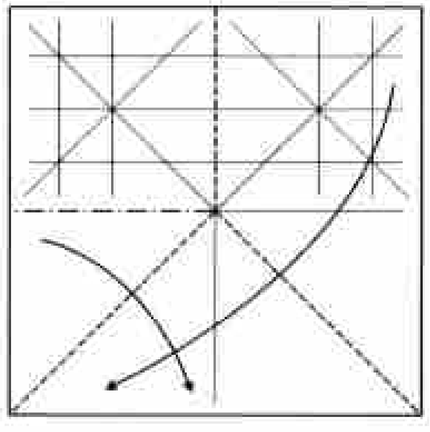
8



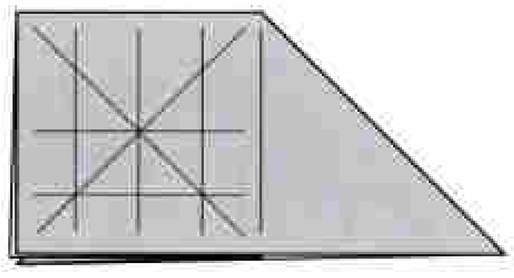
9



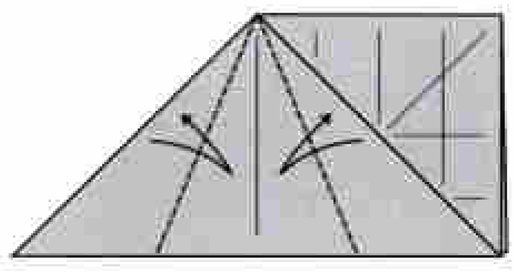
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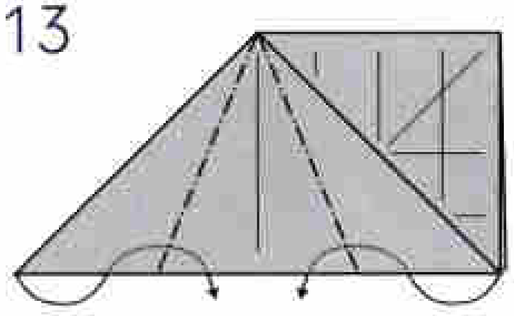
11



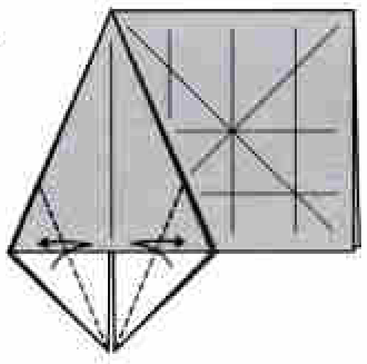
12



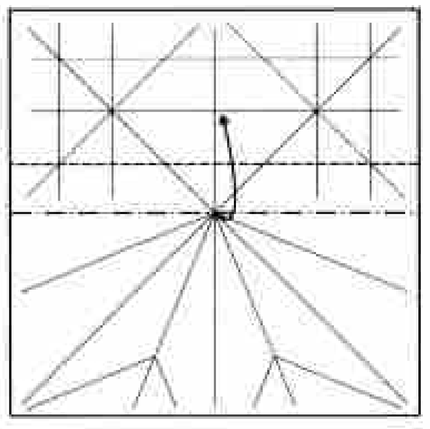
13



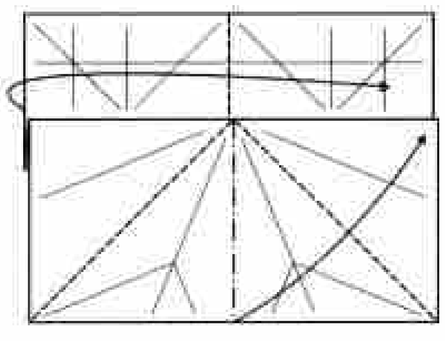
14



15

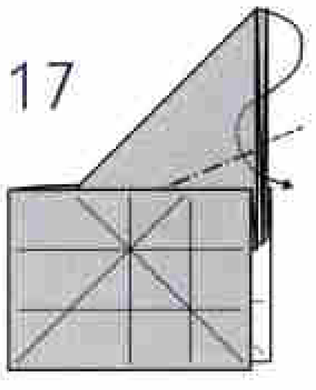


16

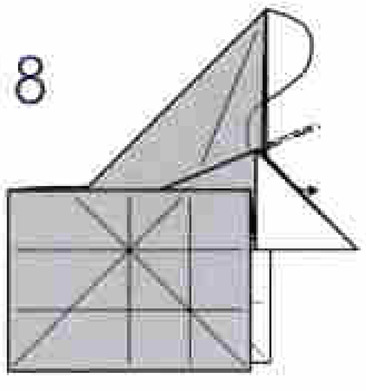




17



18



13
Inside reverse folds.

14
Fold and unfold. Unfold every-thing.

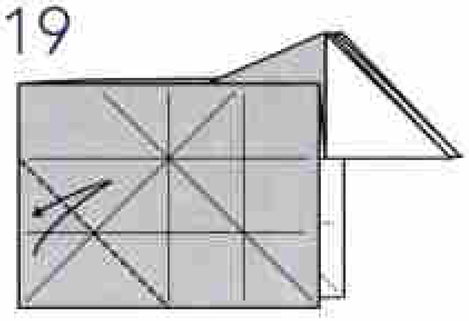
15
Pleat.

17
Inside reverse fold.

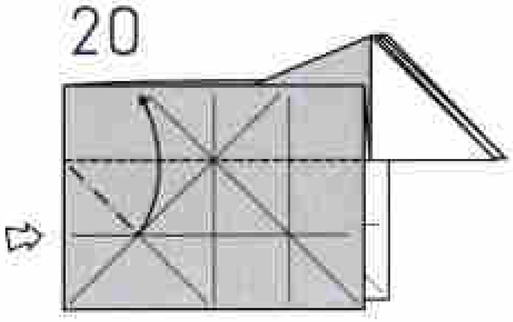
18
Inside reverse fold.

20
Squash.

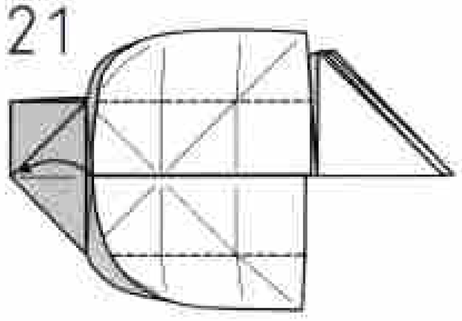
19



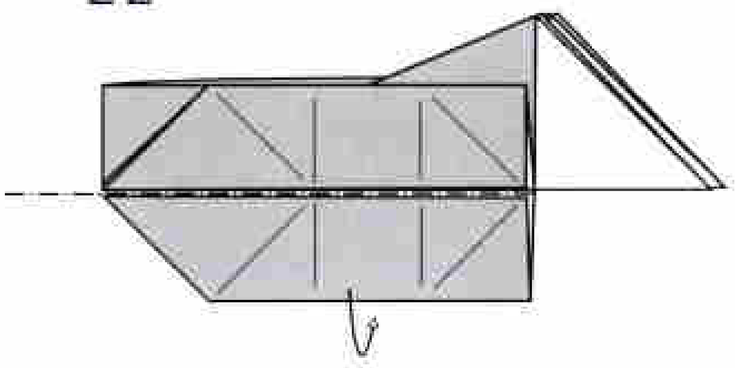
20



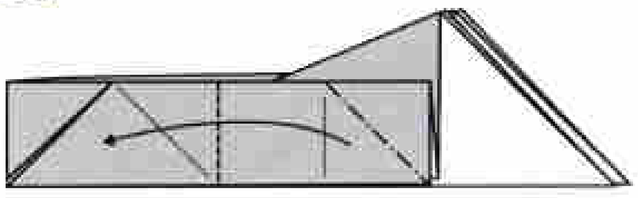
21



22



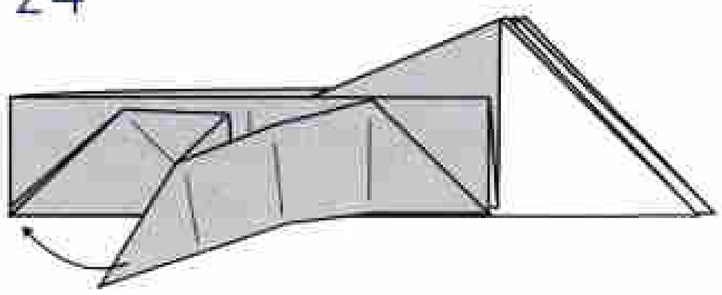
23



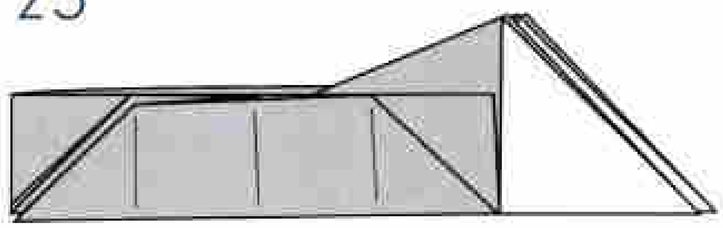
29
Pleat behind.
Sink at arrow.

31
Valley fold.
Repeat steps 23
to 31 behind.

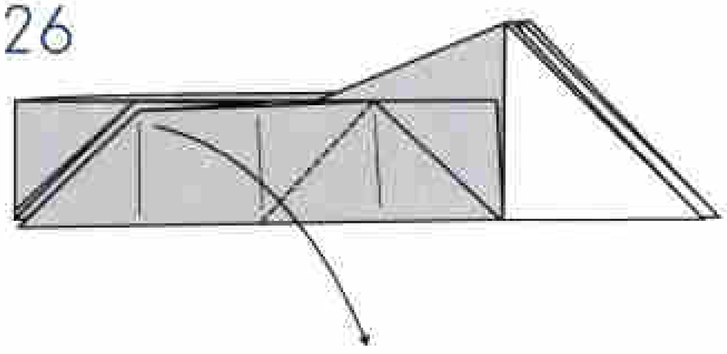
24



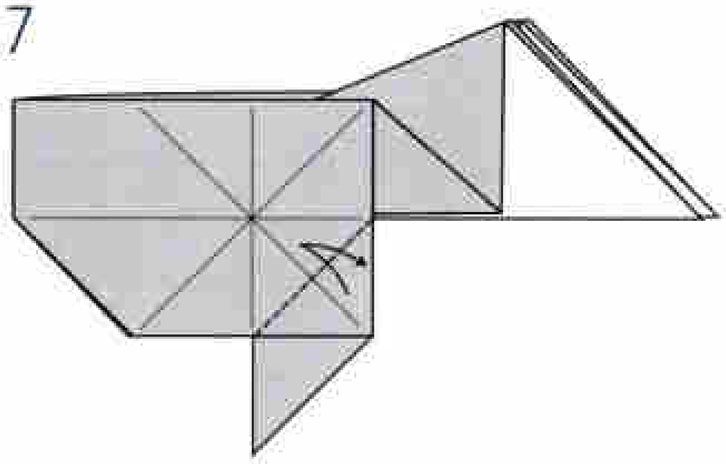
25



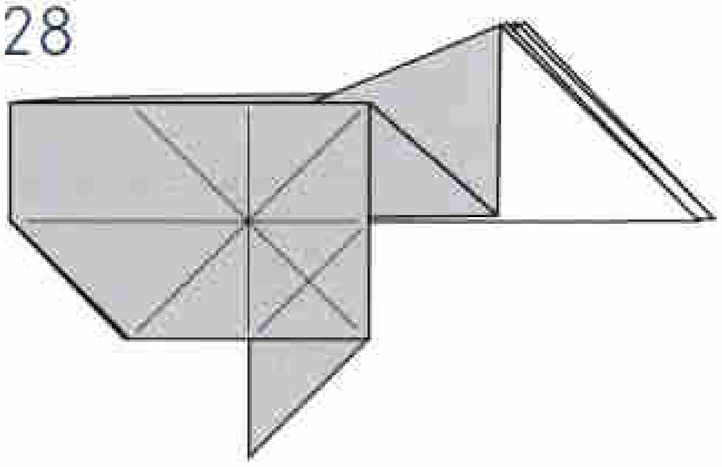
26



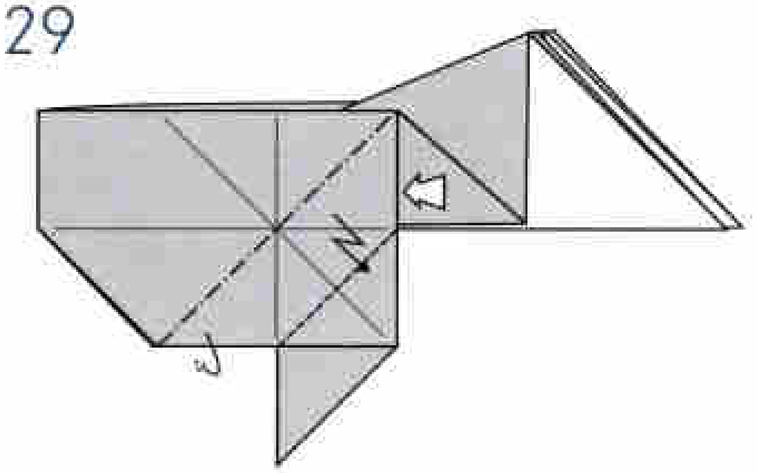
27



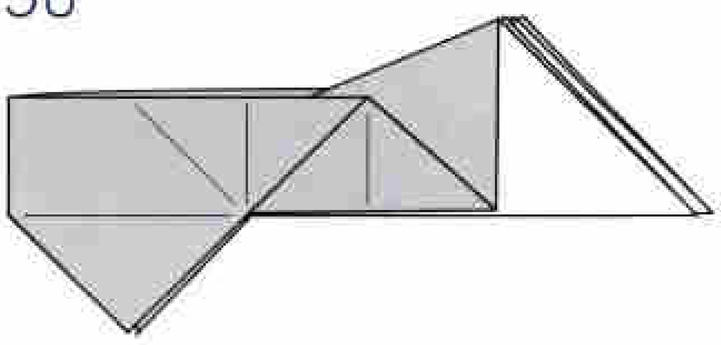
28



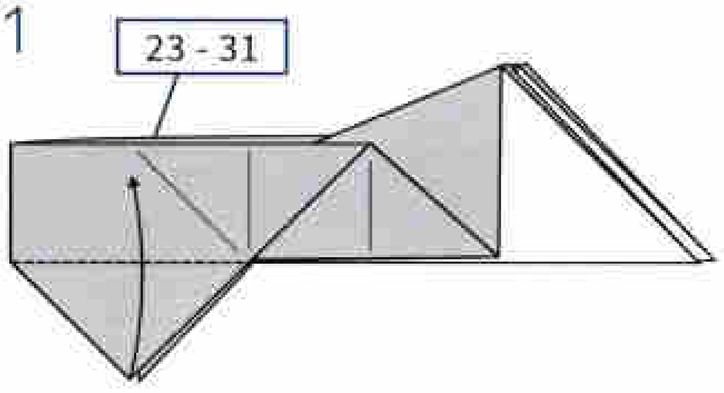
29



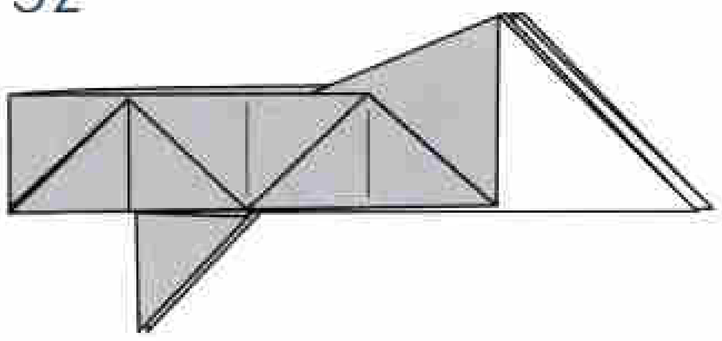
30



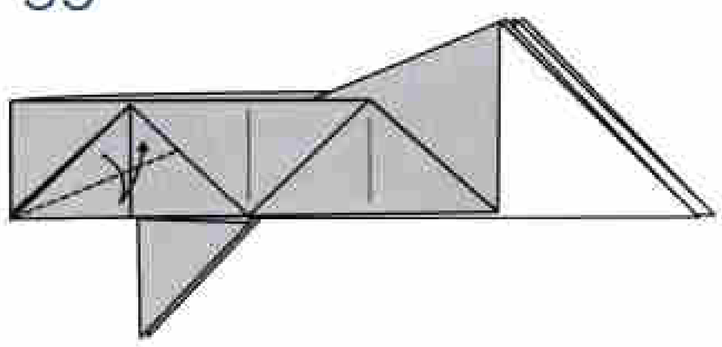
31



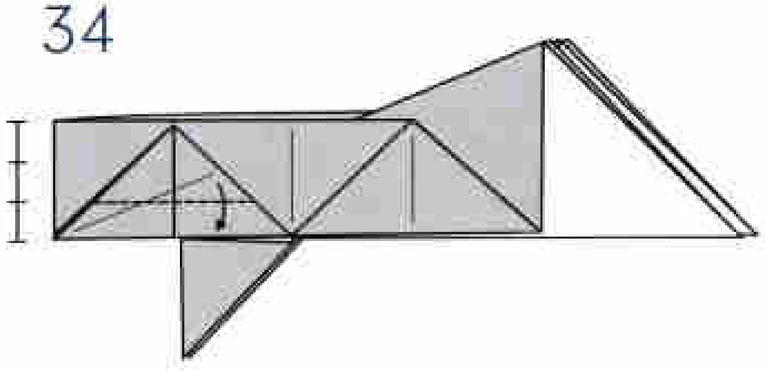
32



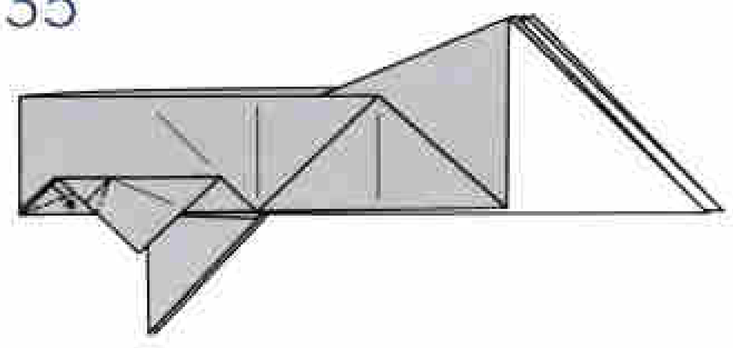
33



34

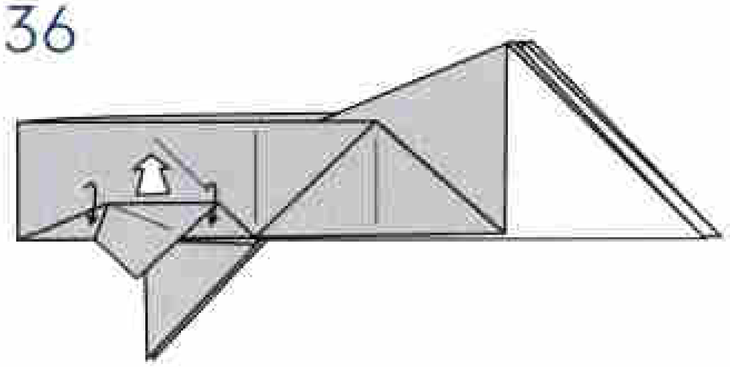


35

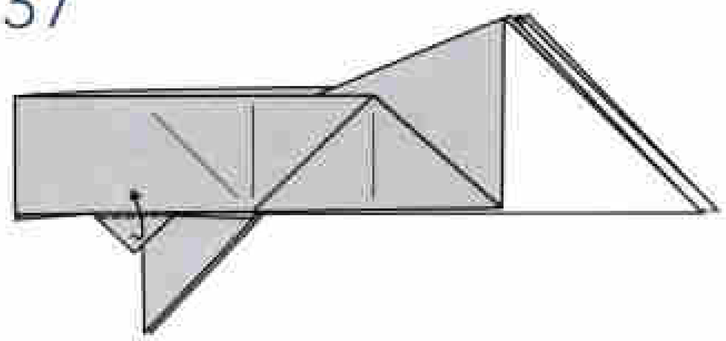


36

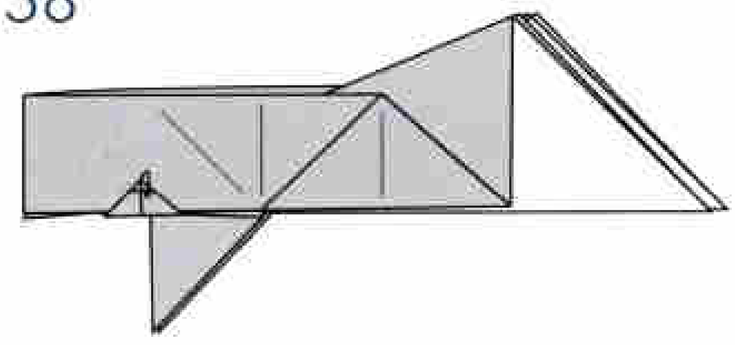
Reverse inside. This is not an easy step.



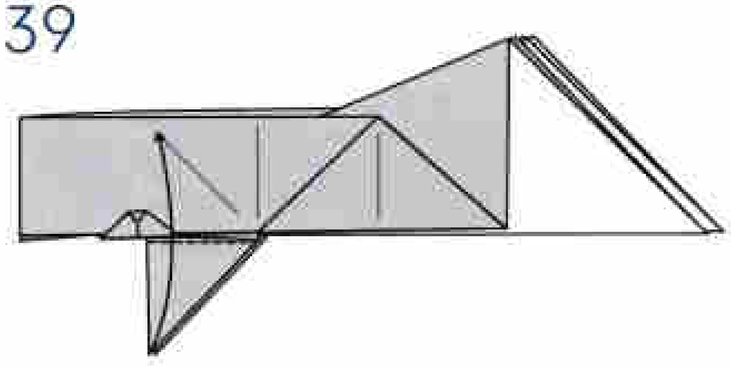
37



38



39

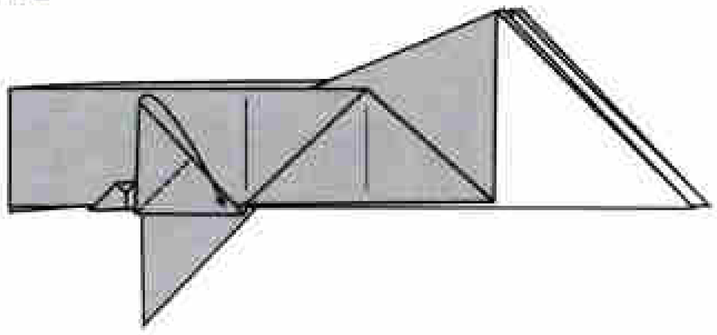


41
Inside reverse fold.

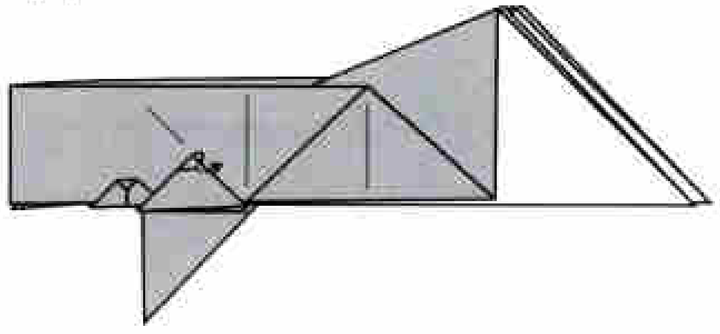
43
Inside reverse fold.

44
Repeat steps 33 to 43 behind.

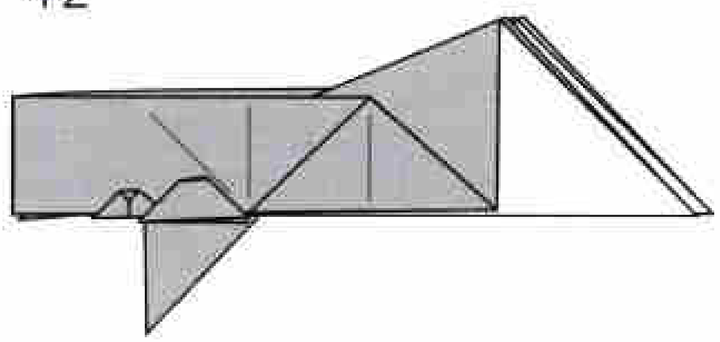
40



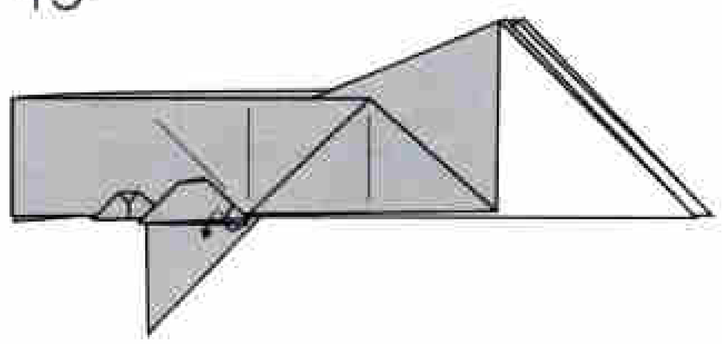
41



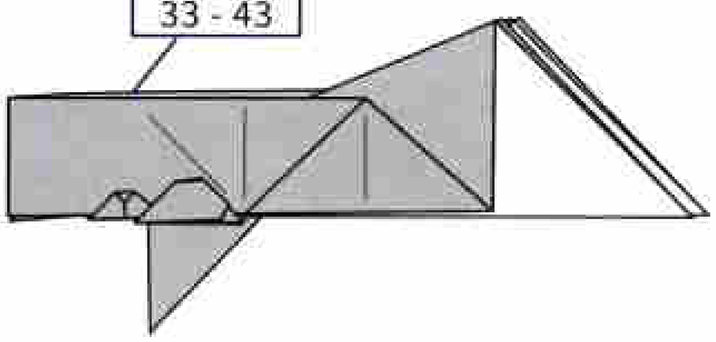
42



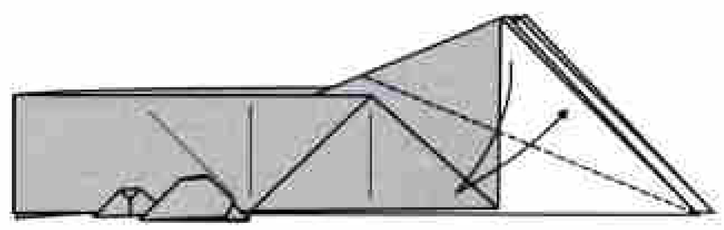
43



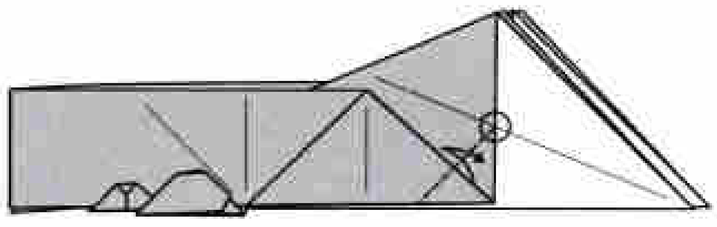
44



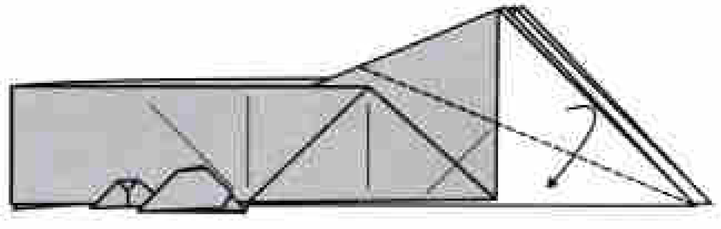
45



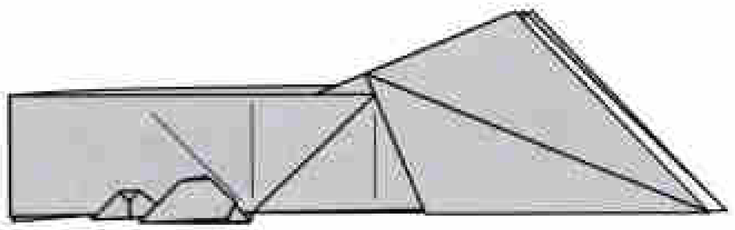
46



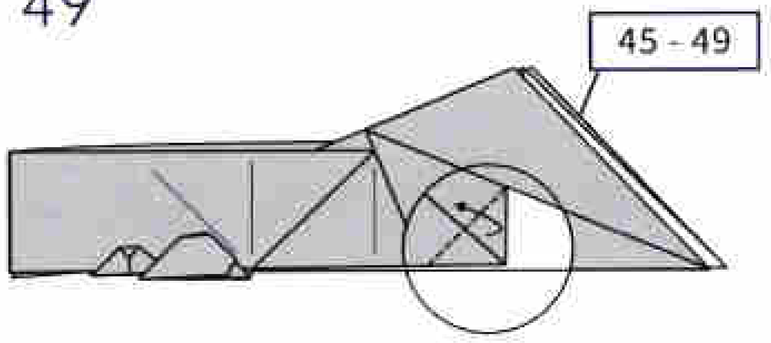
47



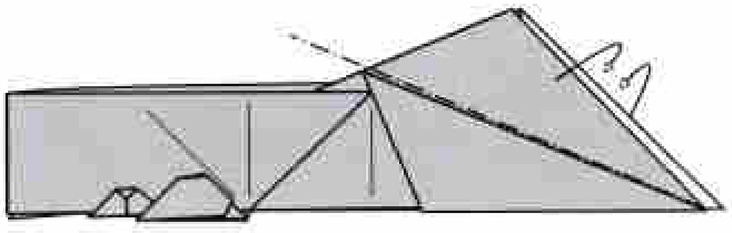
48



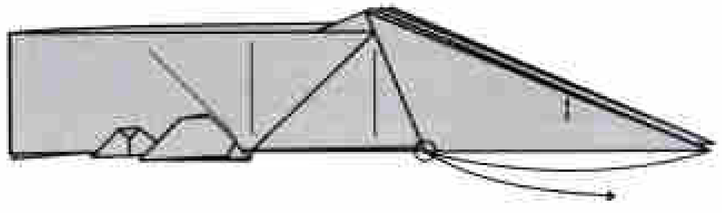
49



50



51



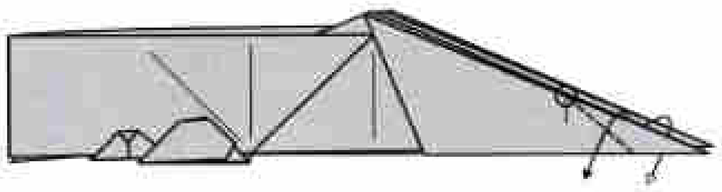
49
Inside view. Tuck the flap into the pocket. Repeat steps 45 to 49 behind.

51
Fold and unfold. Use reference point.

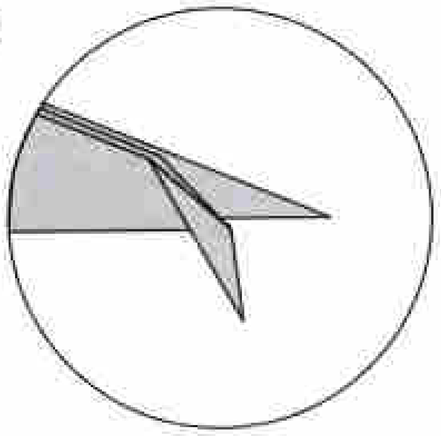
52
Outside reverse fold.

54
Pull out paper.

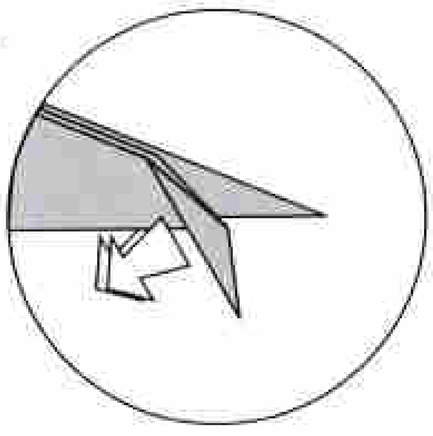
52



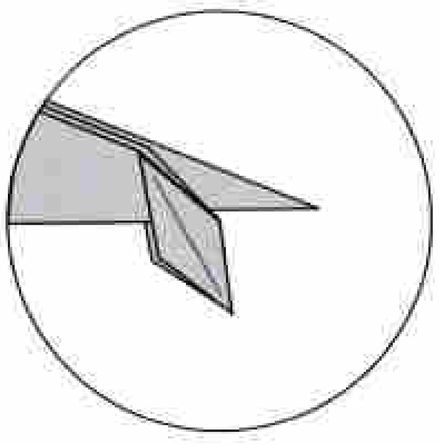
53



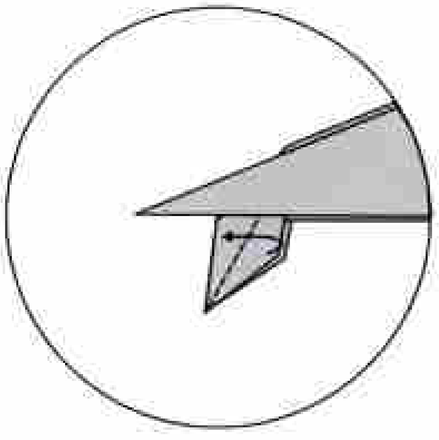
54



55



56



58
Repeat steps 52 to 58 behind.

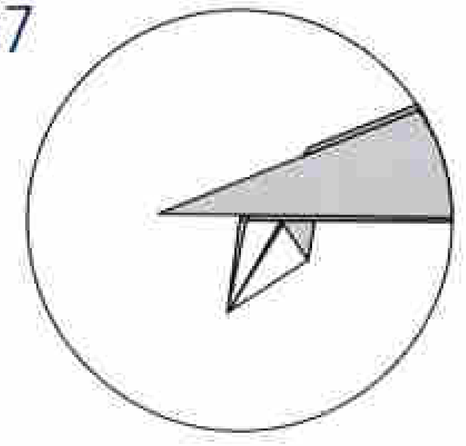
61
Mountain fold the corner.

64
Repeat steps 59 to 63 behind.

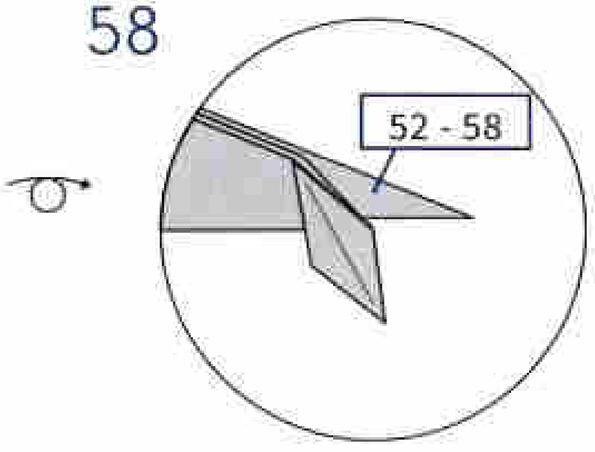
66
Pull out one layer.

67
Tuck flap over other side to lock.

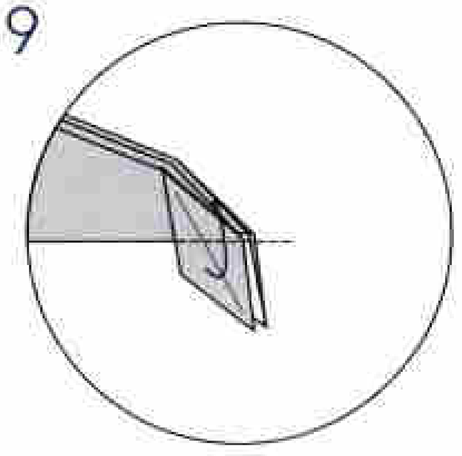
57



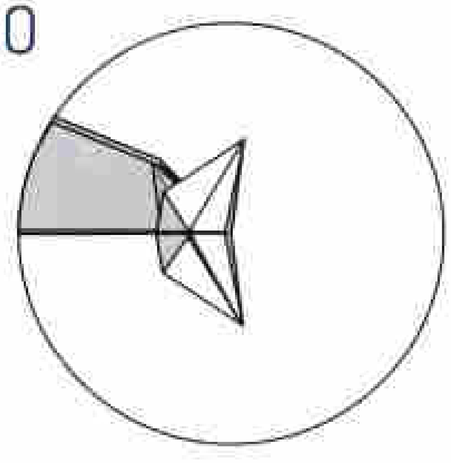
58



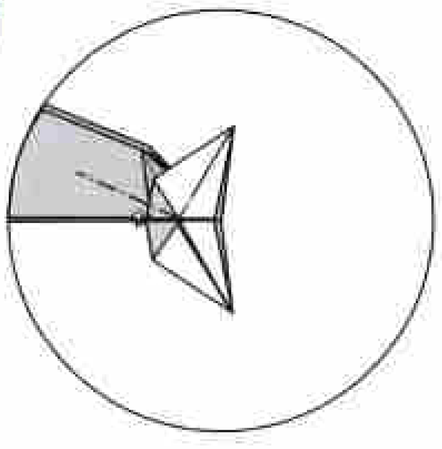
59



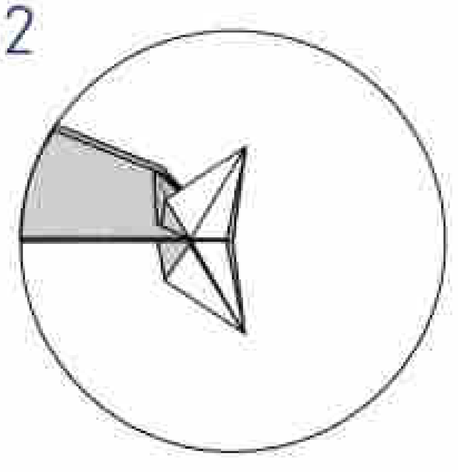
60



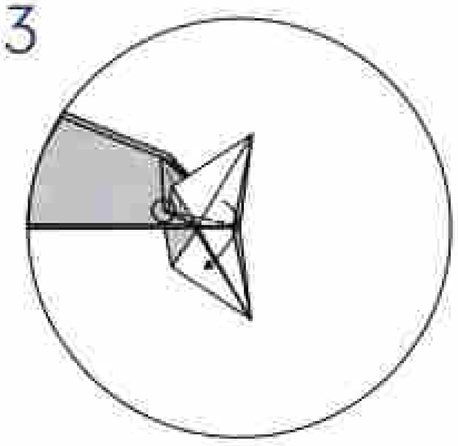
61



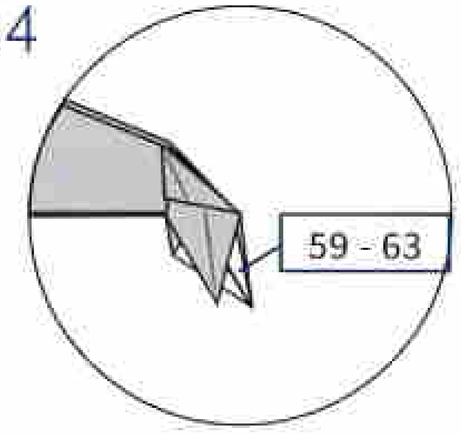
62



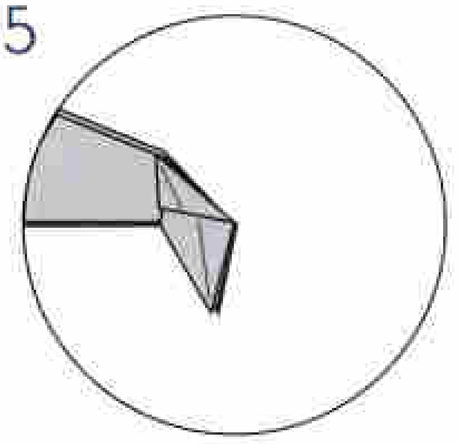
63



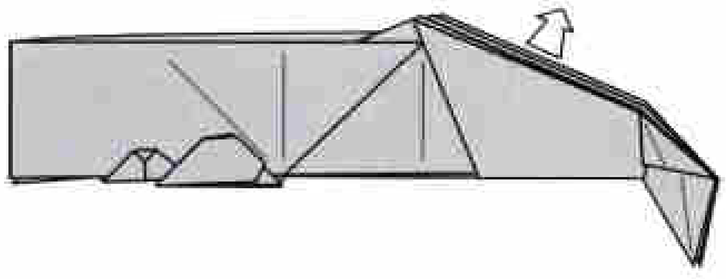
64



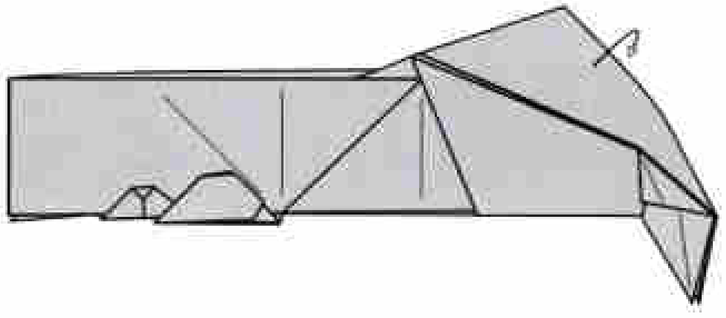
65



66



67

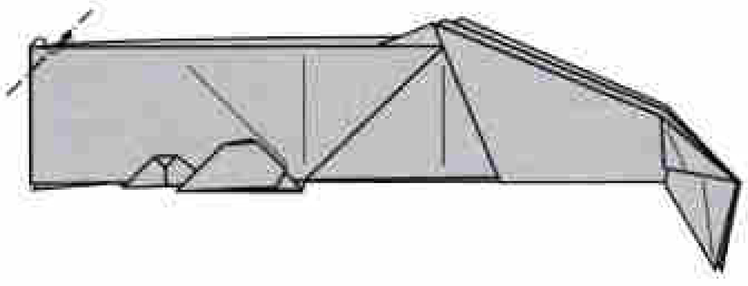


68
Inside reverse fold.

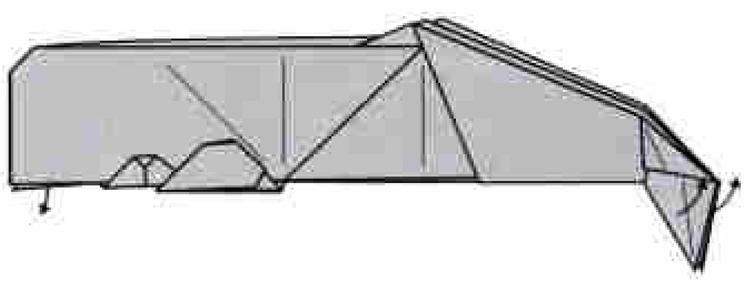
69
Shape.

70
Sperm whale completed.

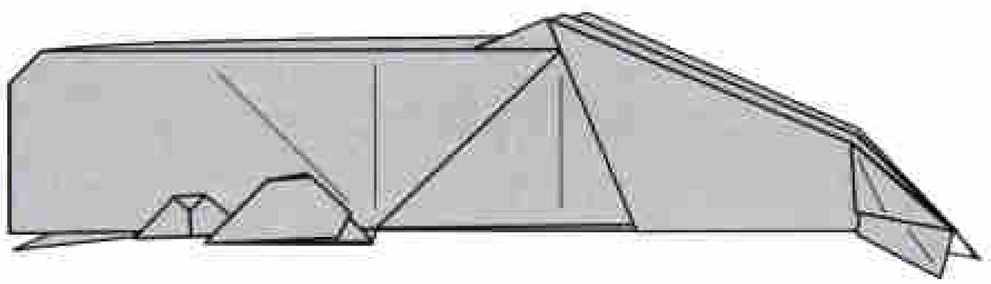
68



69



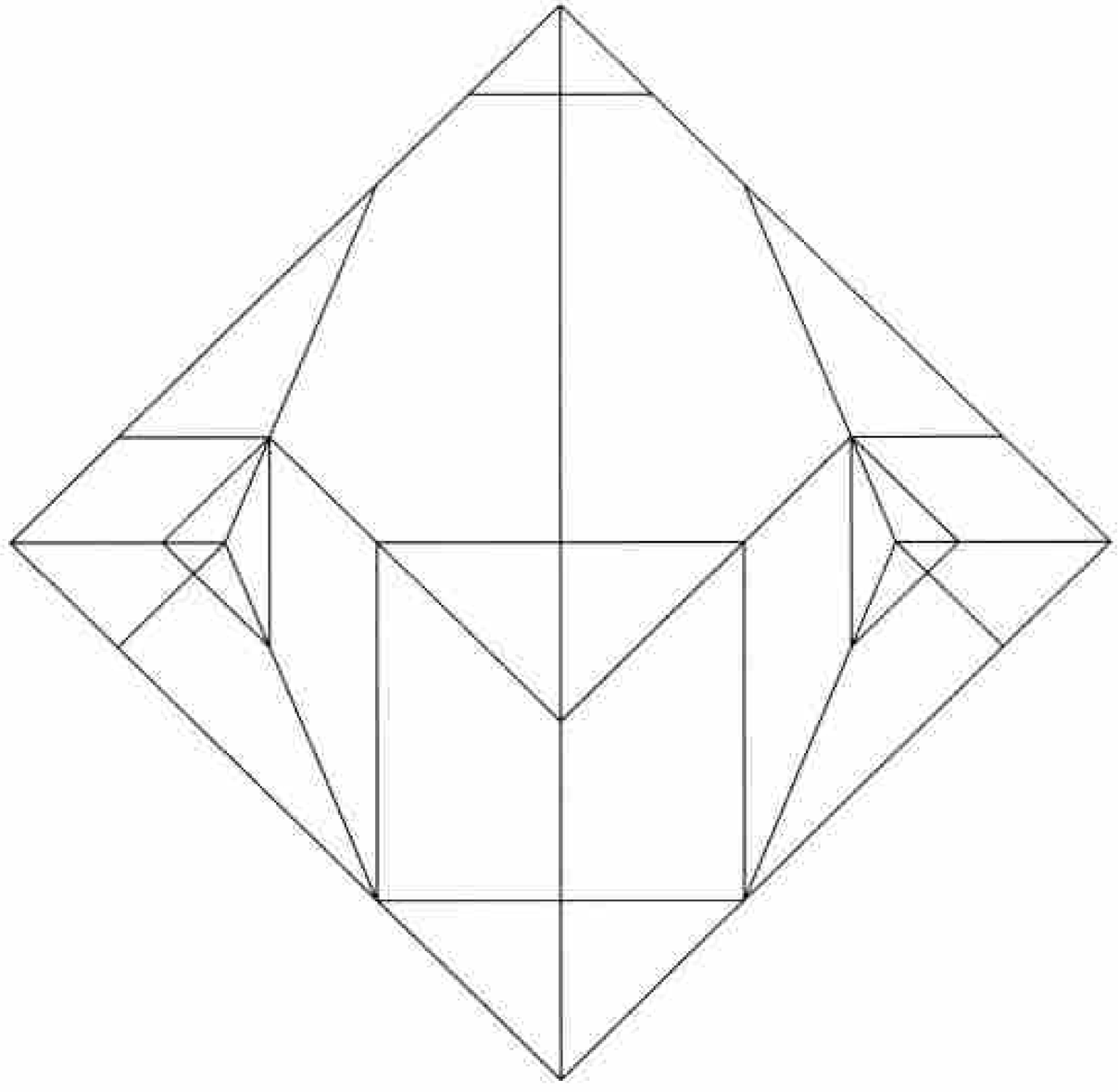
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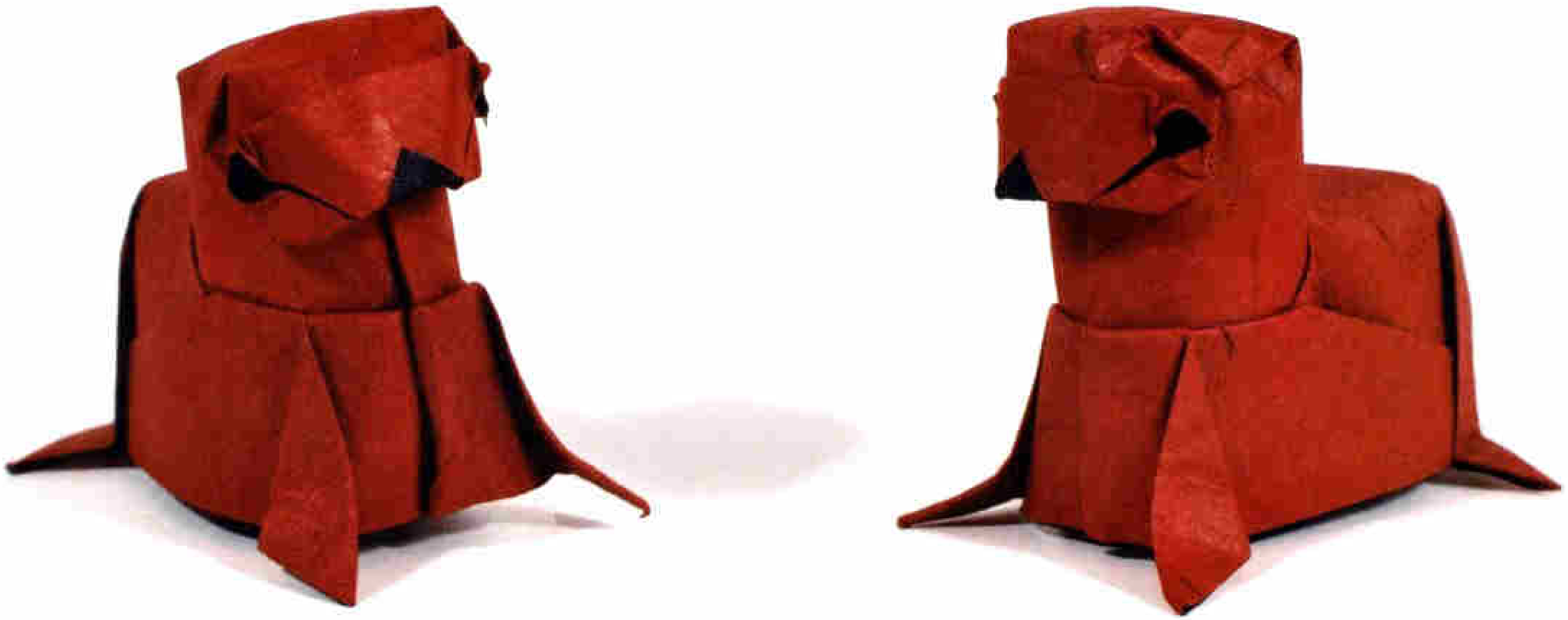


Sea Lion Pup

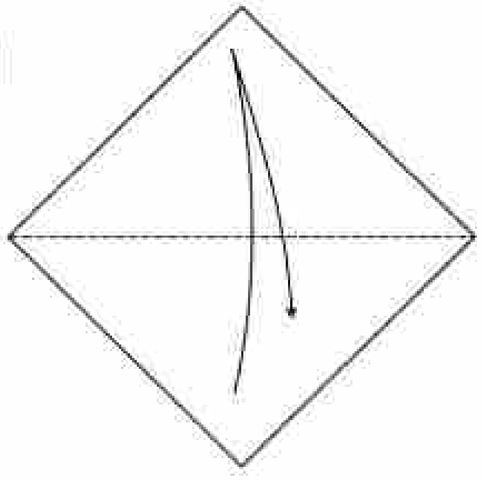
During pupping season, large numbers of seals and sea lions come to a local beach to raise their pups. They spend the majority of the day sunbathing on the sand. In the water, seals and sea lions frequently swim by to inspect what divers are doing.

When I designed the sea lion pup, I wanted to create a design that had no visible openings from any angle. The solution in this model was to turn the neck into a closed cylinder, forming the head by pinching and closing the end of the cylinder. Although the flippers were shorter than desired, I achieved the three-dimensional form I set out for.

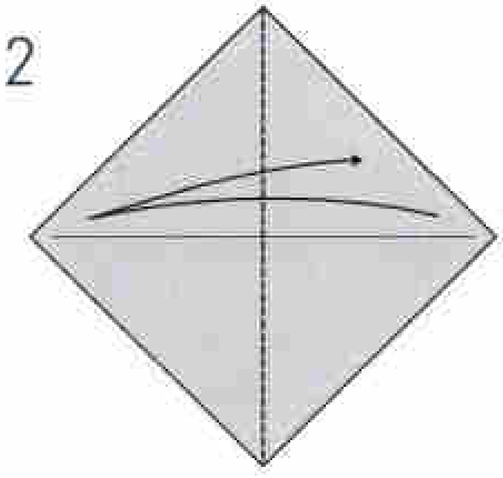




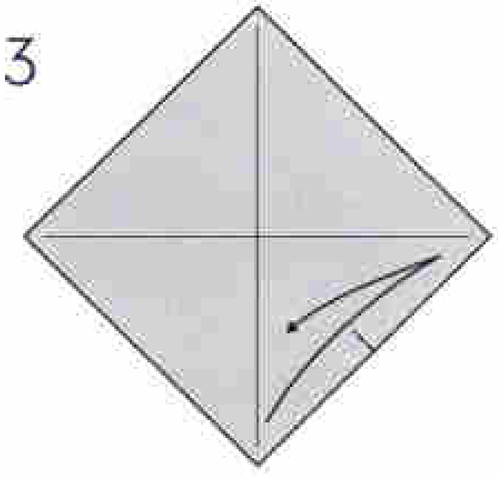
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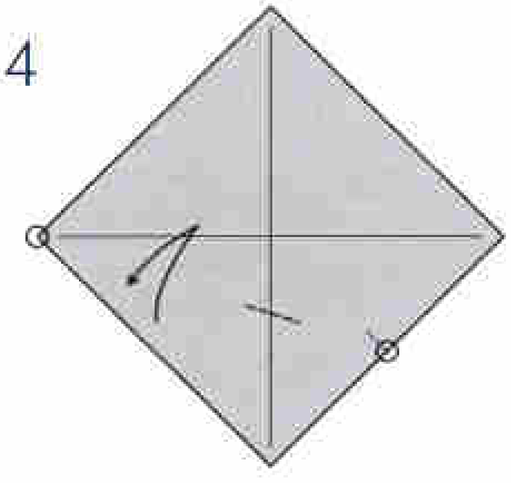
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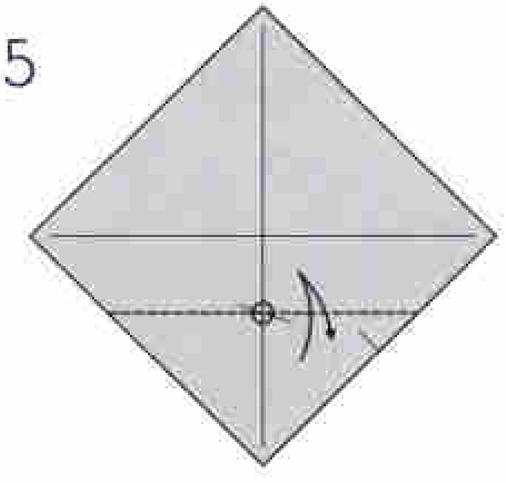
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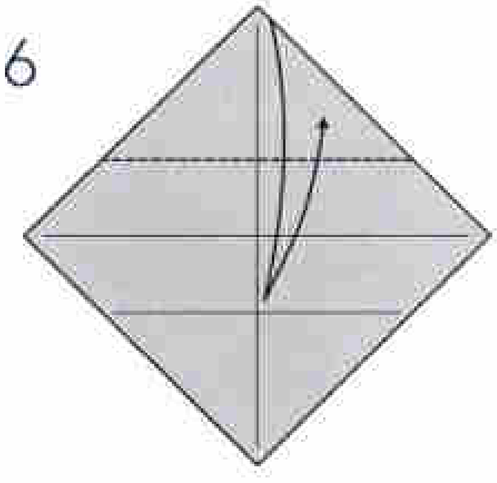
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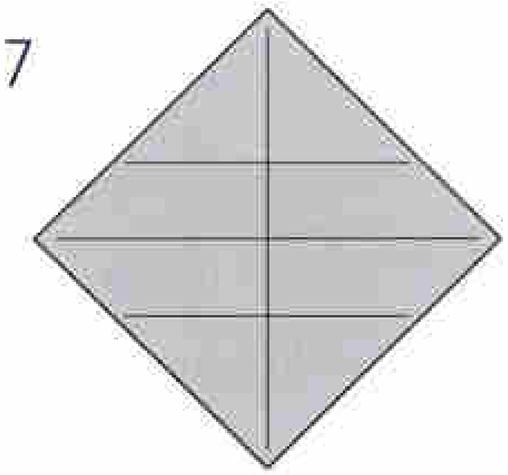
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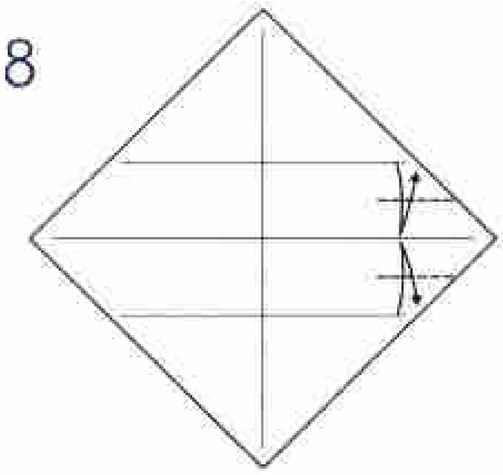
6



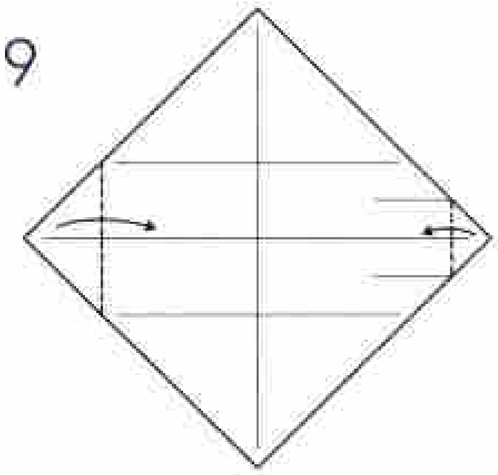
7



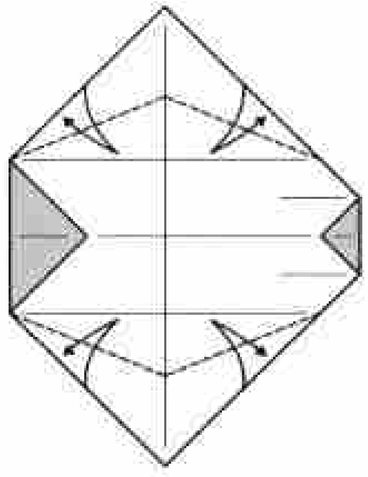
8



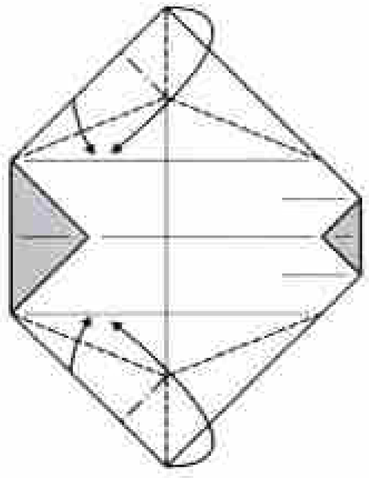
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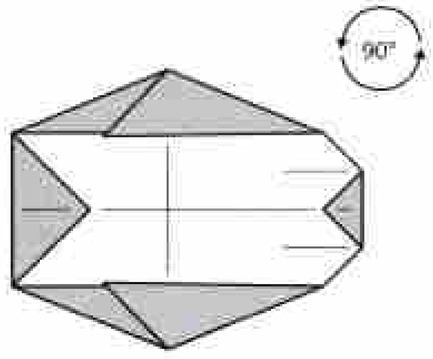
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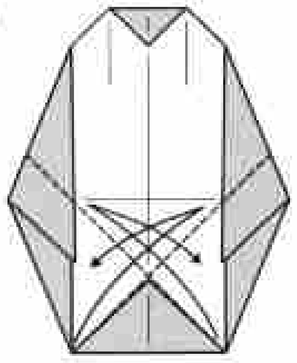
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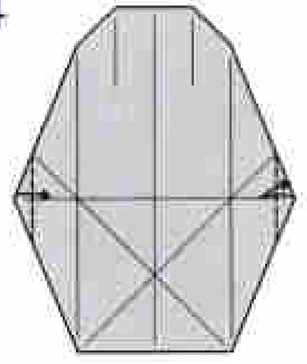
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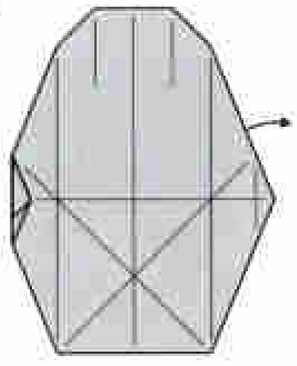
13



14



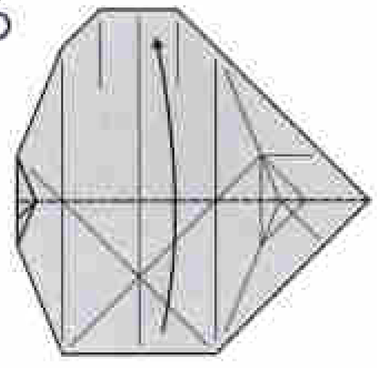
15



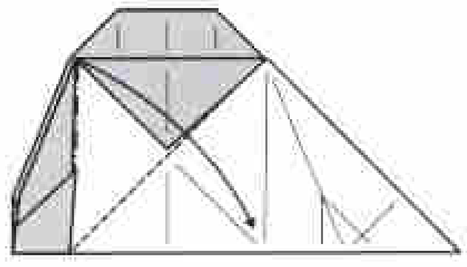
19

Valley fold.
Do not crease through mountain fold.

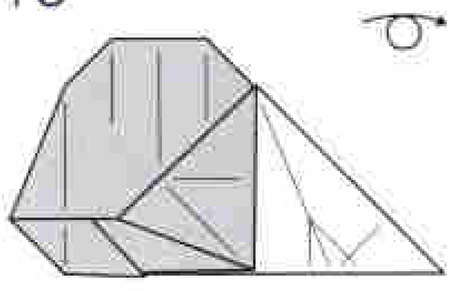
16



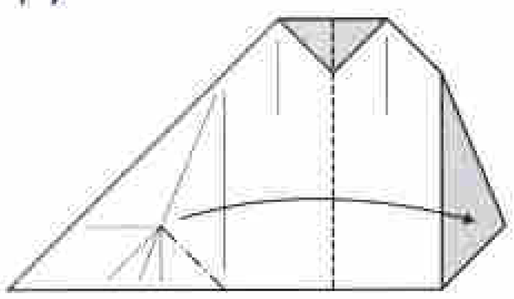
17



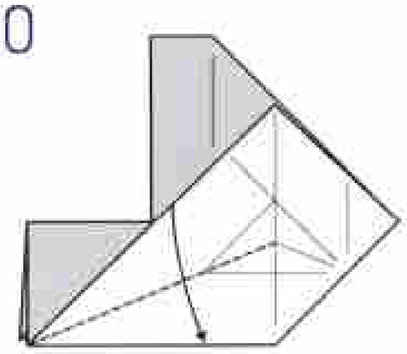
18



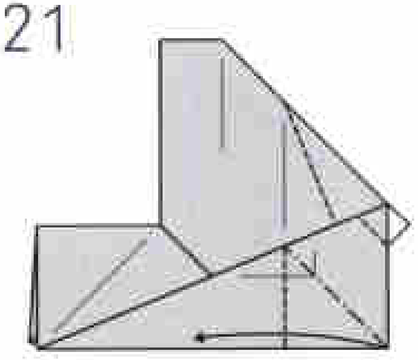
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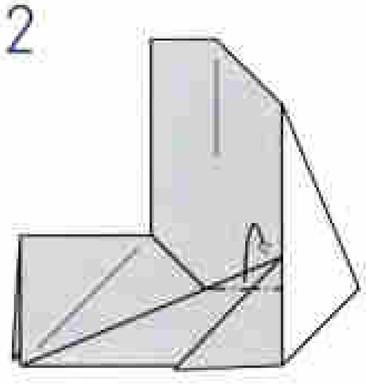
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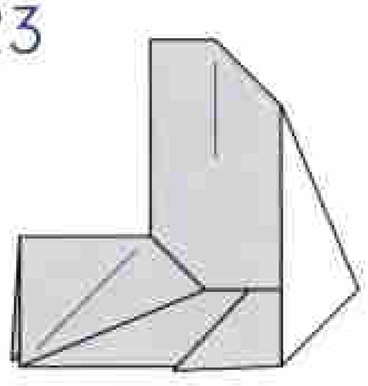
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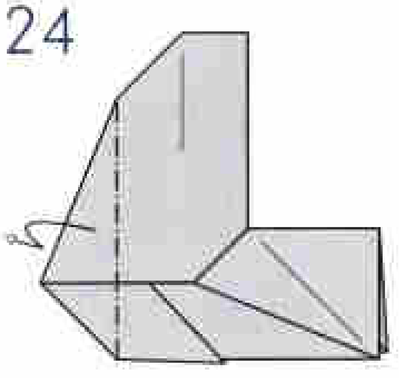
22



23



24



26
Form into a cylinder.

27
Insert flap into pocket.

30
Pull out the paper.

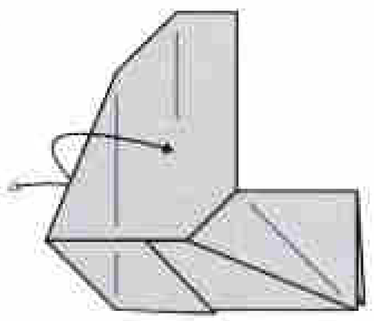
31
Mountain fold over the crimp to lock. Repeat steps 28 to 31 behind.

32
Inside reverse fold.

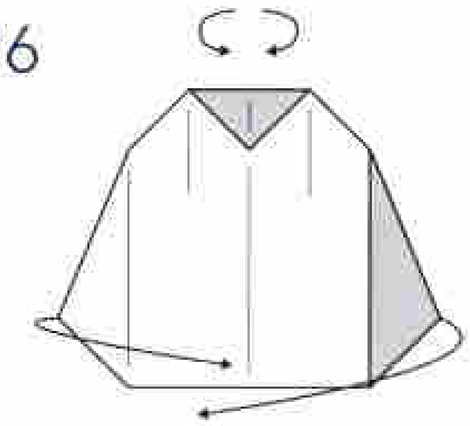
33
Angle bisector to lock.

35
Repeat step 34 behind.

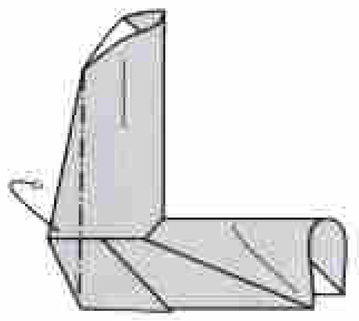
25



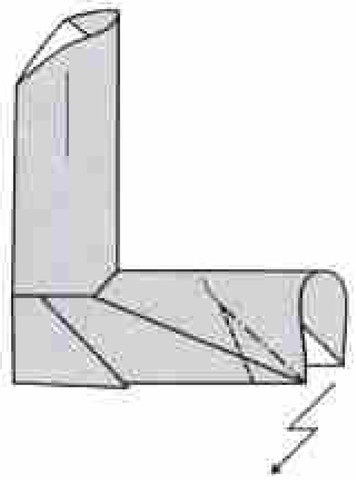
26



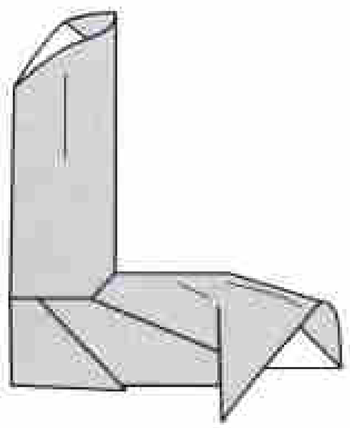
27



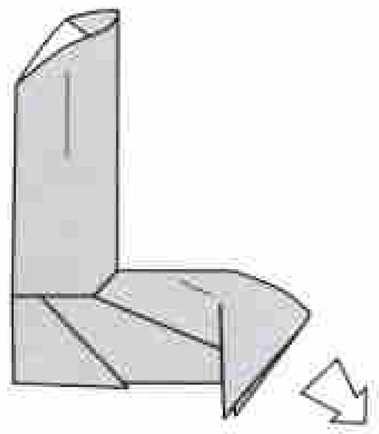
28



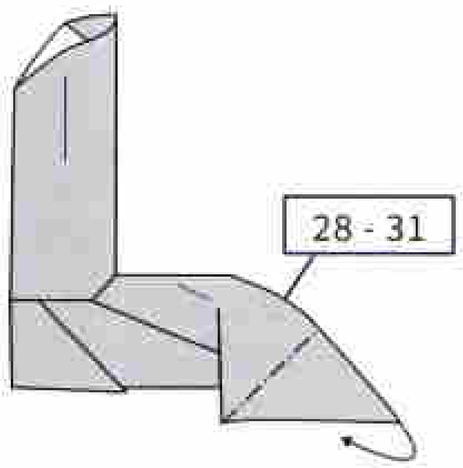
29



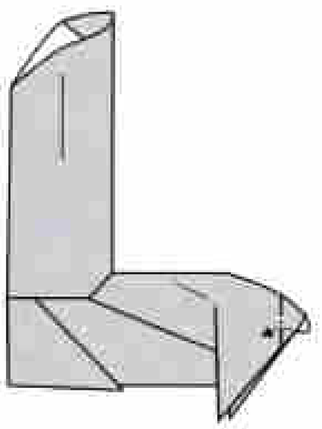
30



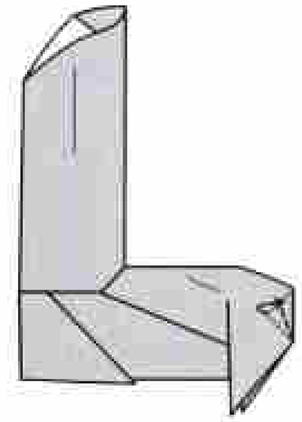
31



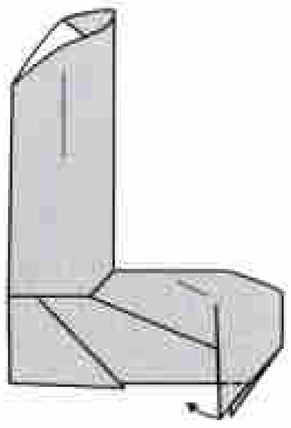
32



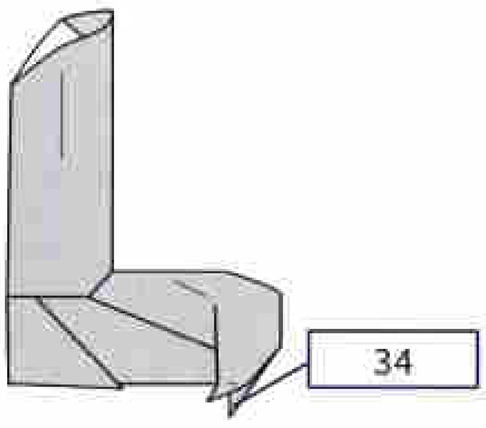
33



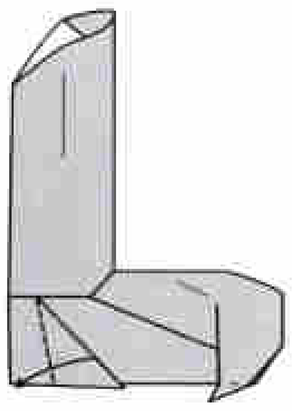
34



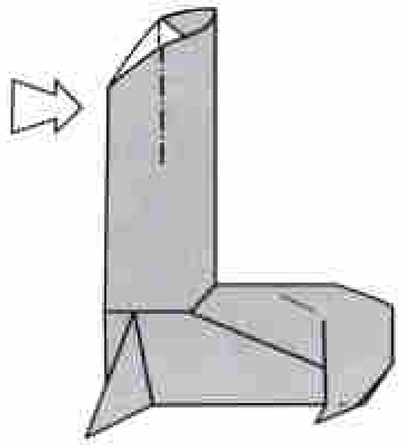
35



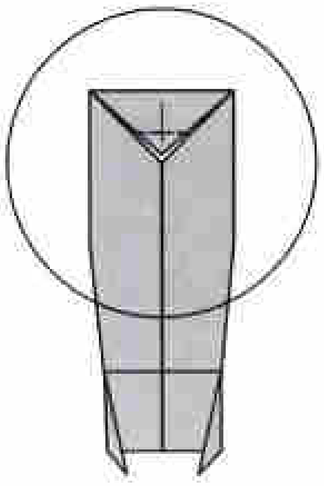
36



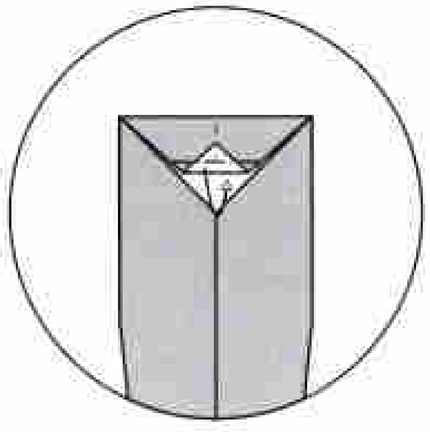
37



38



39



40

Squash the corners to form eyes.

44

Reform the neck into a cyclinder.

45

Fold head down and collapse the sides as shown.

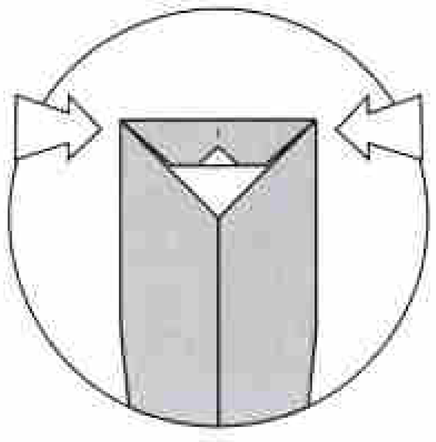
47

Shape.

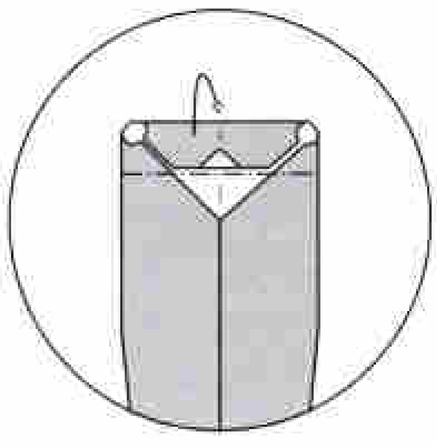
48

Fur seal pup completed.

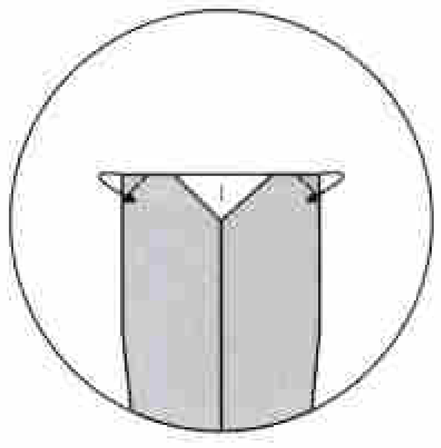
40



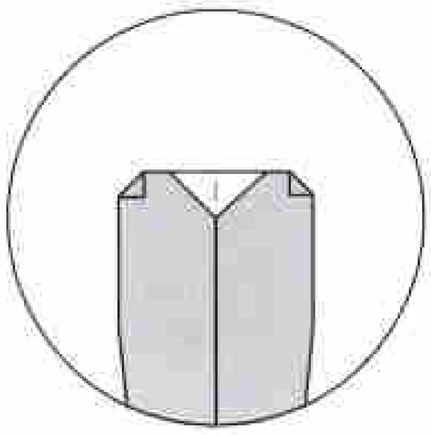
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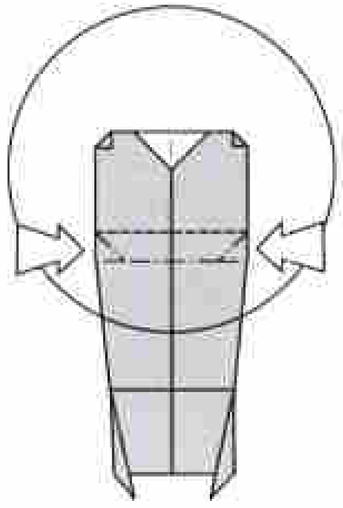
42



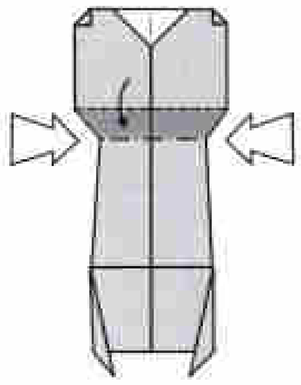
43



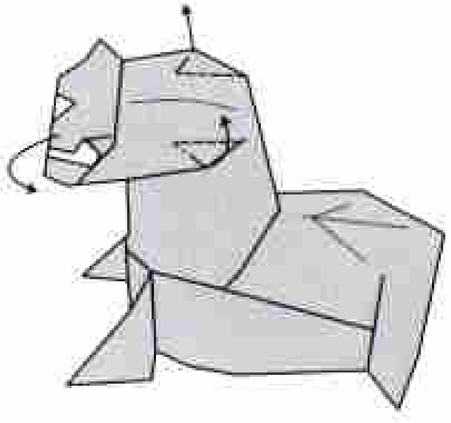
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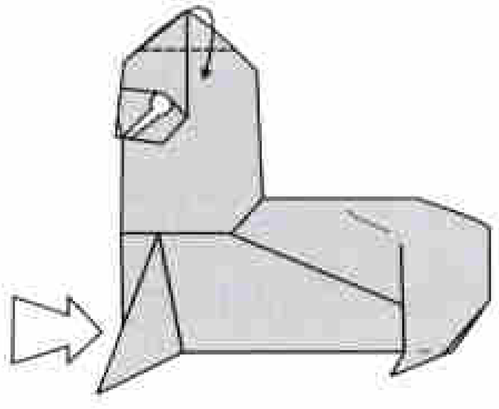
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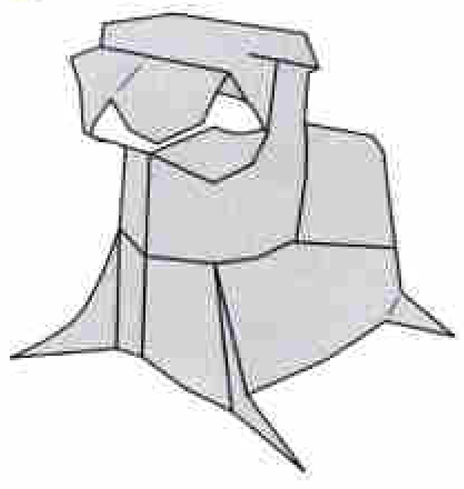
46



47



48



Sea Turtles

Green Sea Turtle Hatchlings

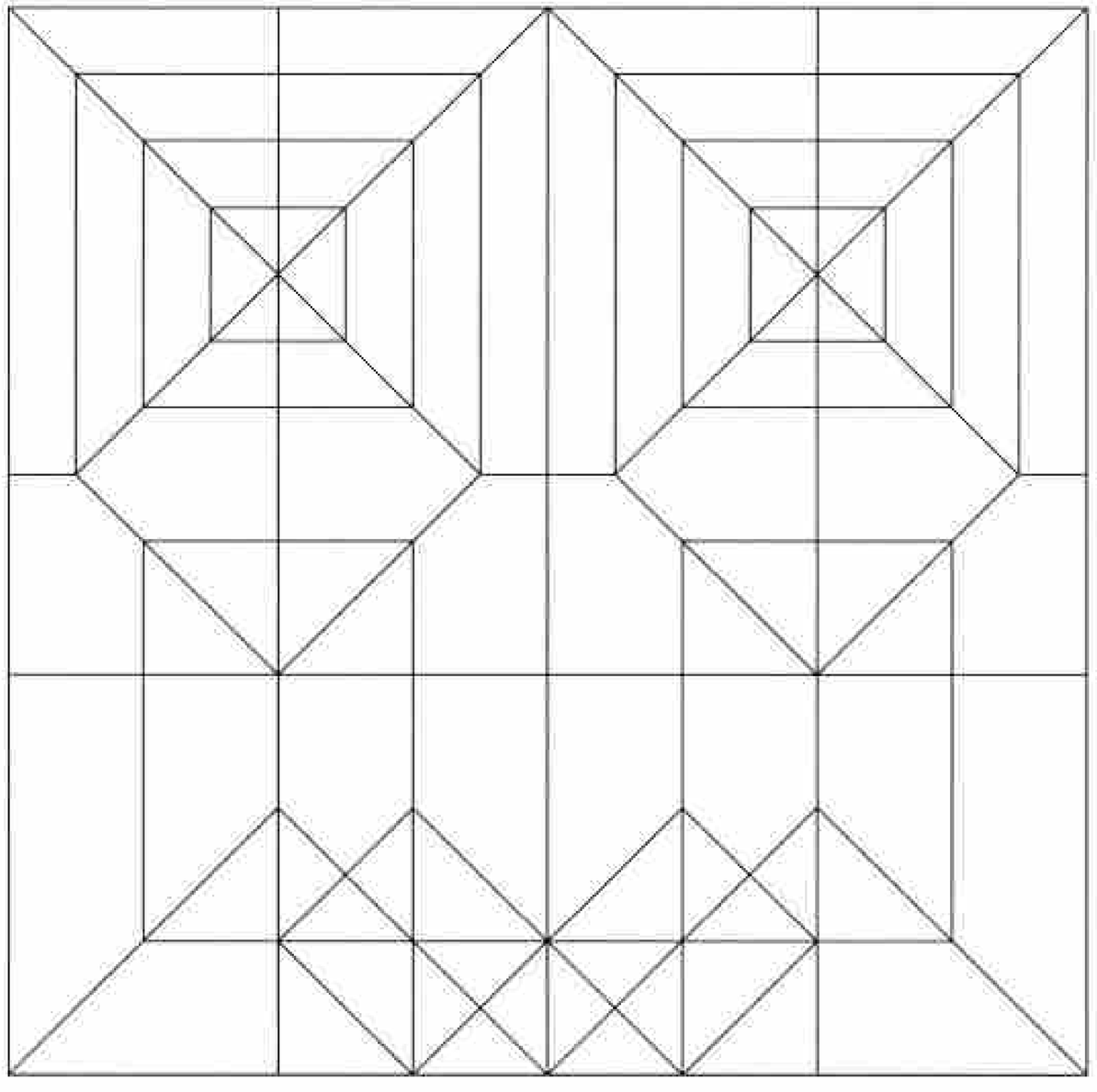
Sea Turtle

Sea Turtle Shell

Green Sea Turtle Hatchling

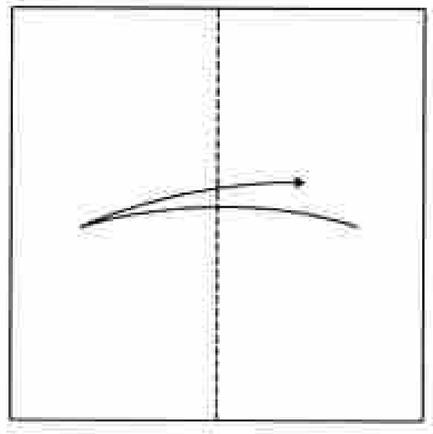
The green sea turtle hatchling is one of my most successful and favorite models. Several features highlight this design: the distribution of layers in the body allows the shell to be lifted from the belly, and the hind flippers are folded with a triple interlocking flap sequence. Interestingly, this model requires almost no precreasing at the beginning.

An interesting fact about green turtles is that the gender is determined by the temperature in which the eggs incubate. Below 27.7° C (81.86° F) hatchlings will be male, above 31°C (87.7° F) hatchlings will be female, and between that range, there will be a mix of genders. As coastal regions increase in temperature due to climate change, many sea turtle populations are being threatened by the reduction of males.

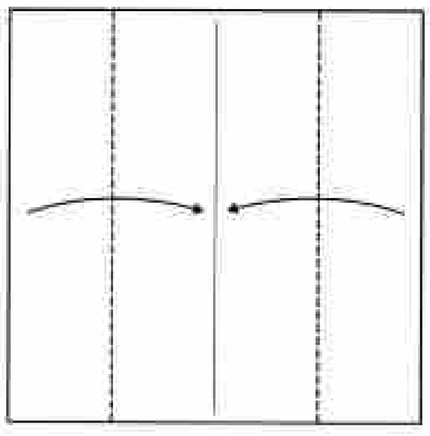




1



2



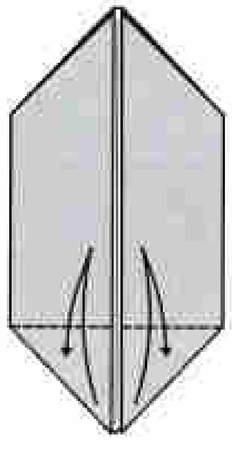
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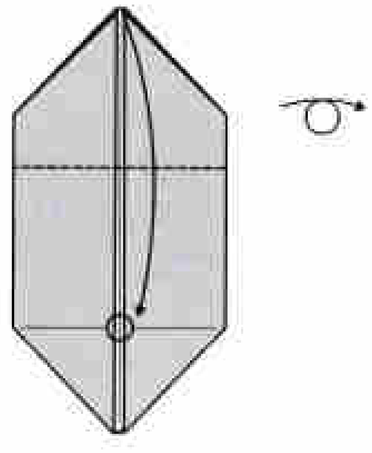
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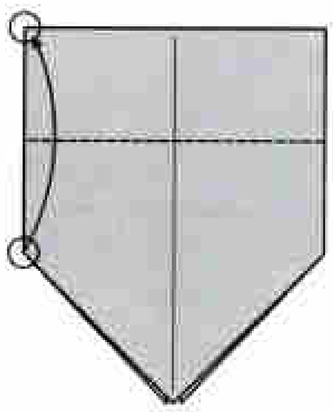
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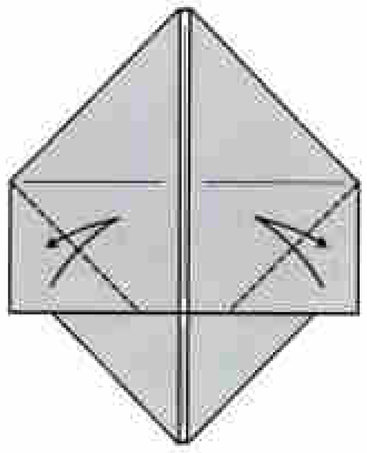
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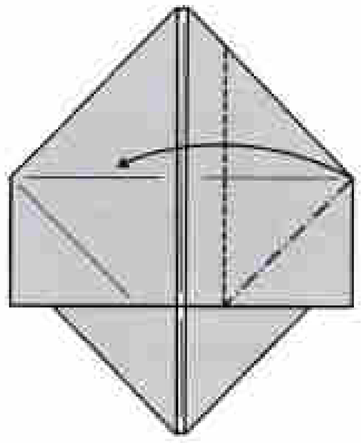
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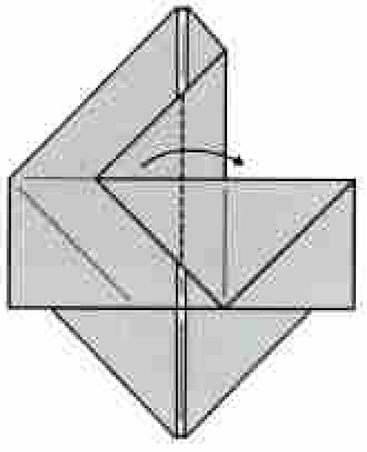
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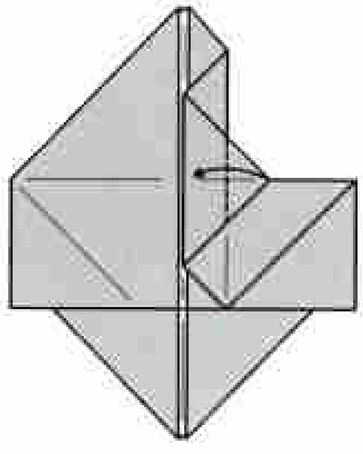
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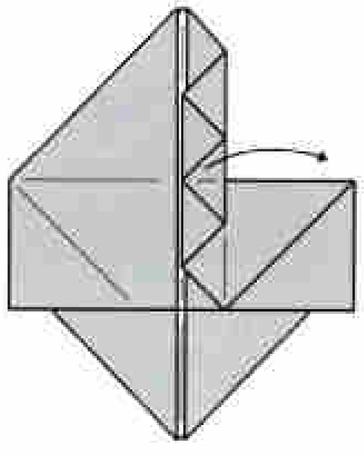
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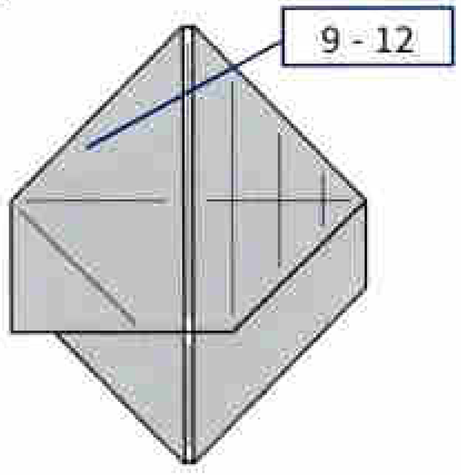
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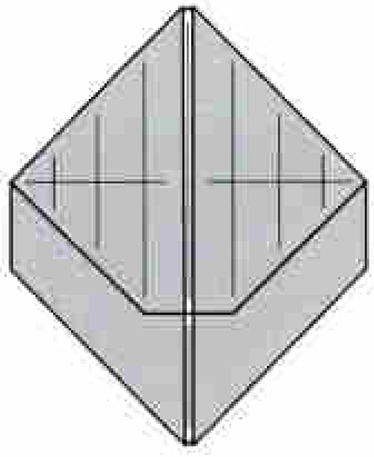
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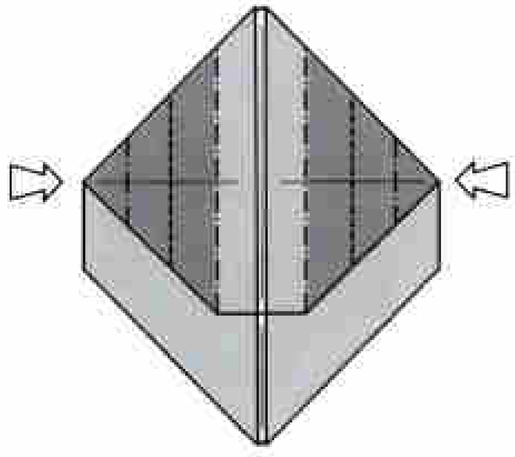
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14



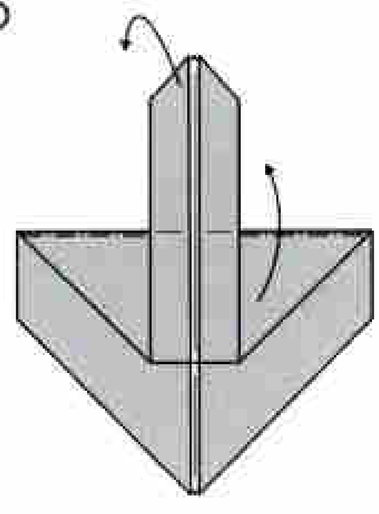
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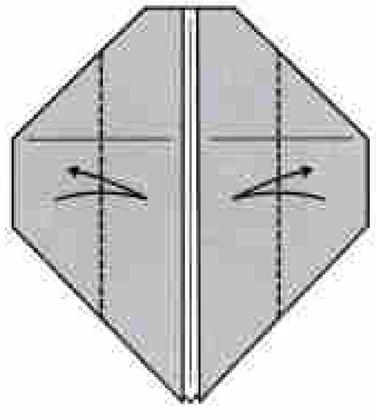
13
Repeat steps 9 to 12 on the left side.

15
Closed sink on the bottom. Open sink at the top.

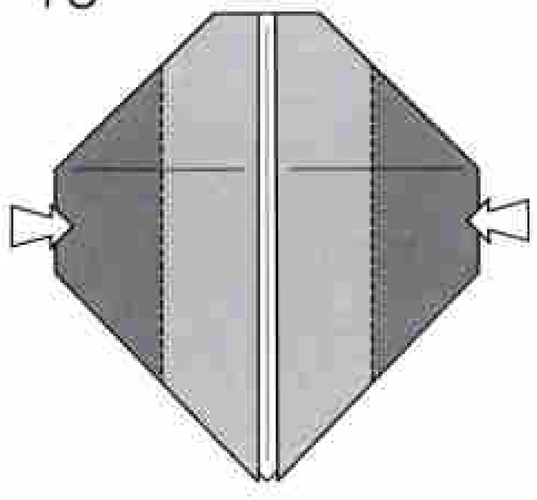
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17



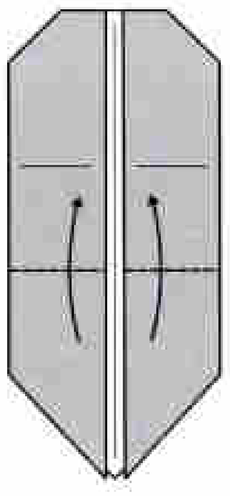
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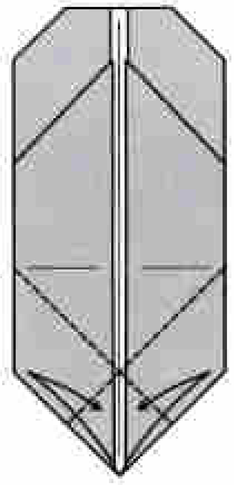
18
Closed sink at the top. Open sink at the bottom.

21
Mountain fold and unfold.

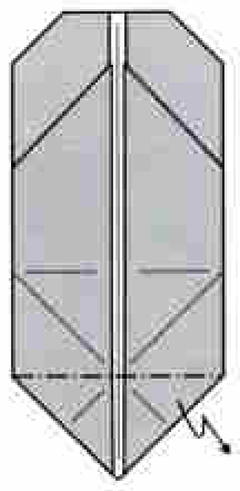
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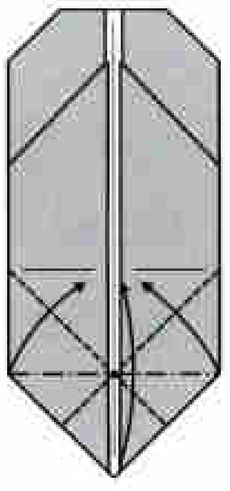
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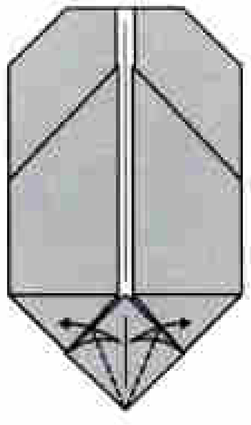
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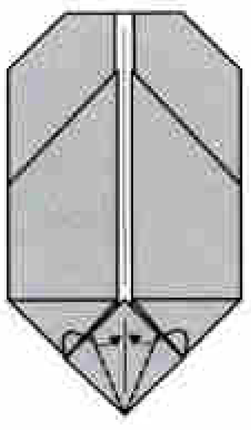
22



23



24



26
Bring one flap to the left.

27
Hide the flap underneath.

28
In progress.

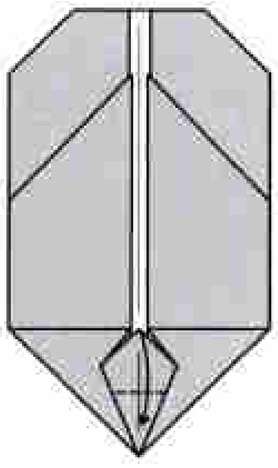
30
Repeat steps 26 to 29 on the left side.

33
Crimp lightly.

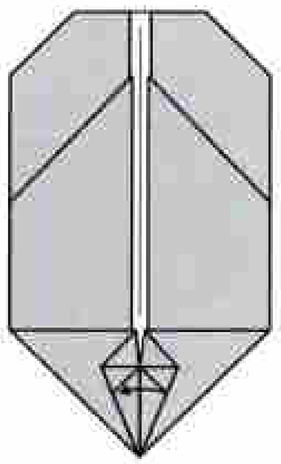
35
Reference point determined in step 37.

36
Valley fold.

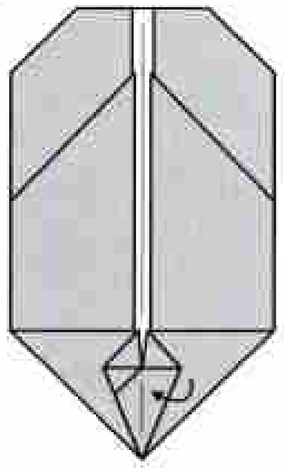
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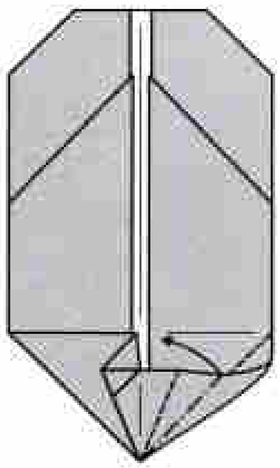
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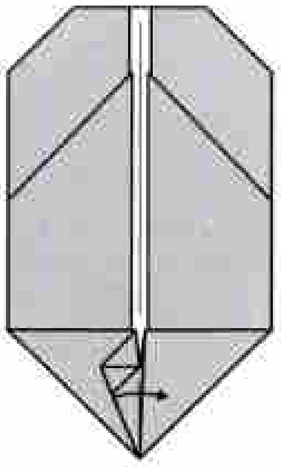
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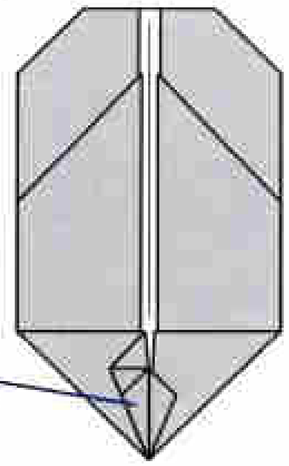
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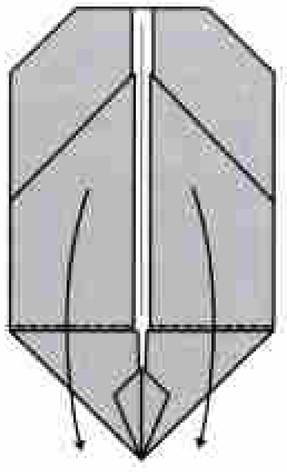
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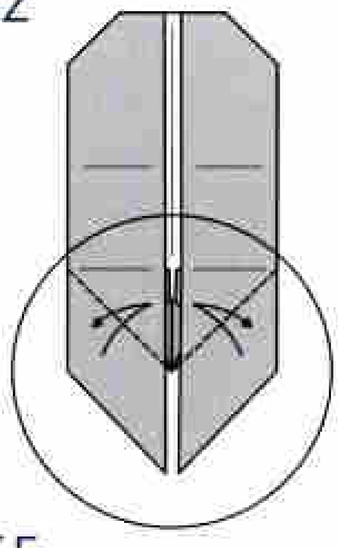
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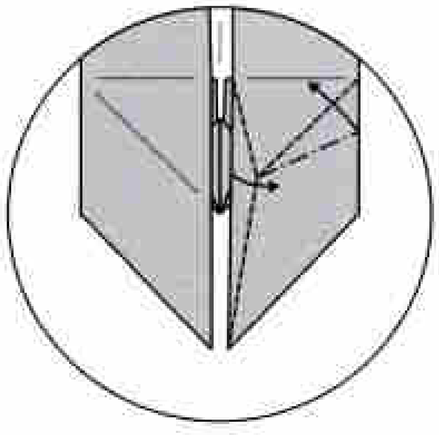
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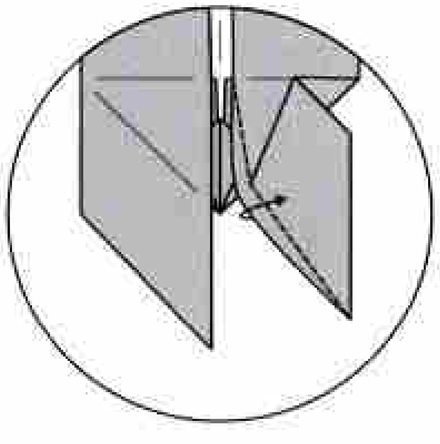
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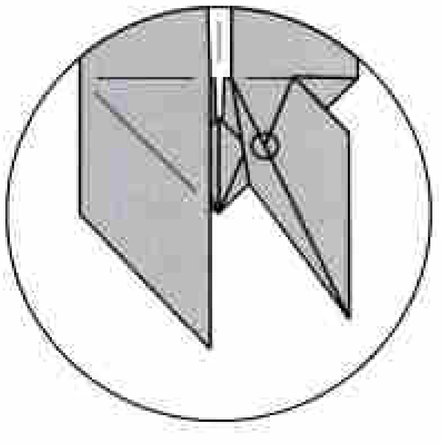
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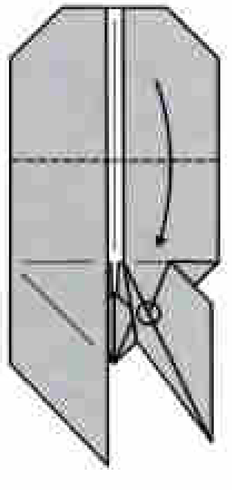
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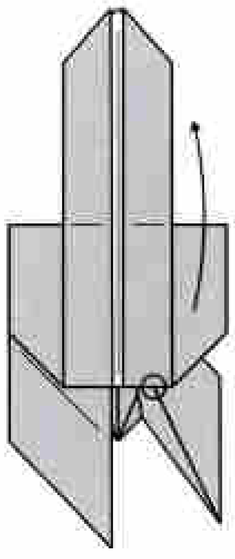
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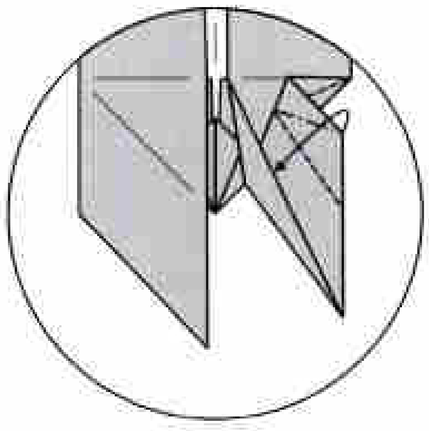
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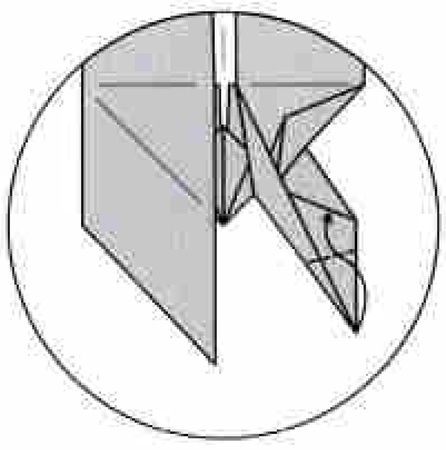
37



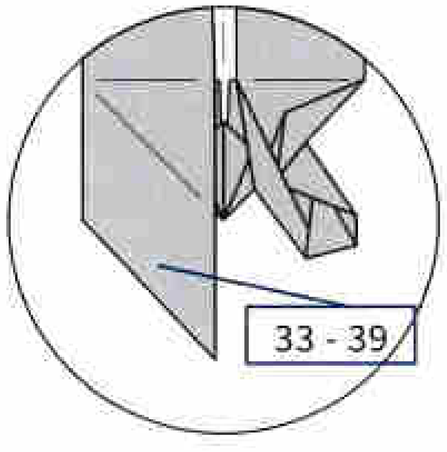
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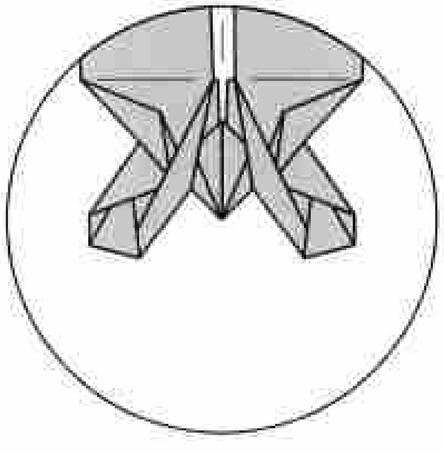
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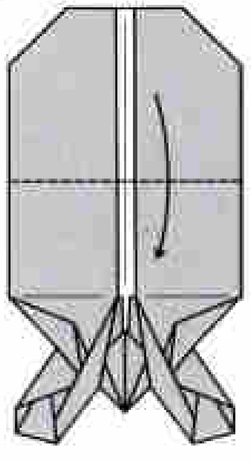
40



41



42



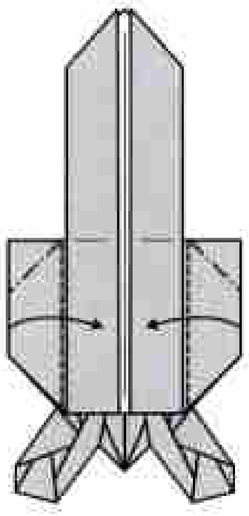
37
The edges of the three flaps should intersect at one point.

38
Petal fold. Tuck corner under the opposite flap.

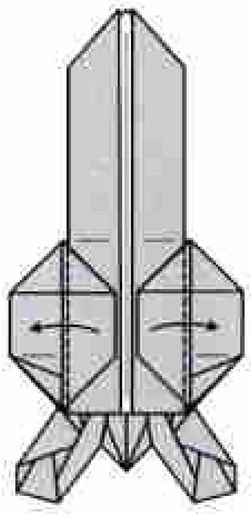
39
Valley fold. Tuck corner under the opposite flap.

40
All flaps should be locked. Repeat steps 33 to 39 on the left side.

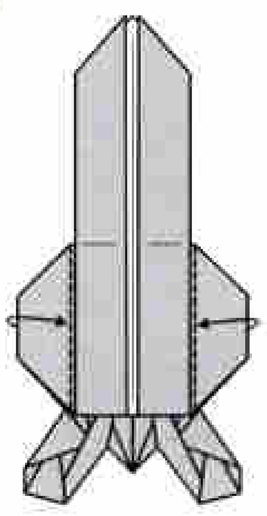
43



44



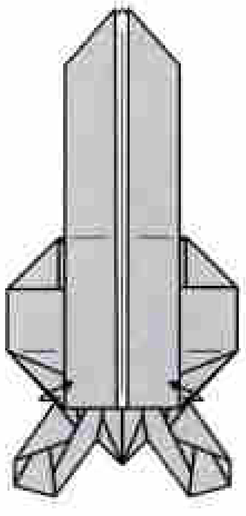
45



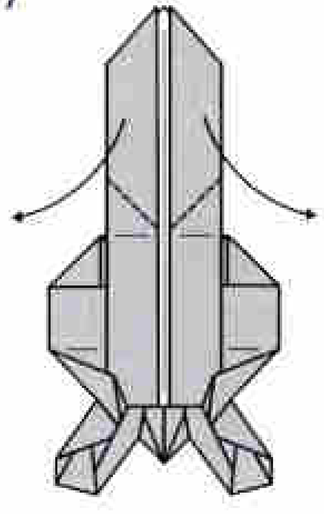
45
Tuck the flaps inside.

46
Tuck the corners of the body flap under.

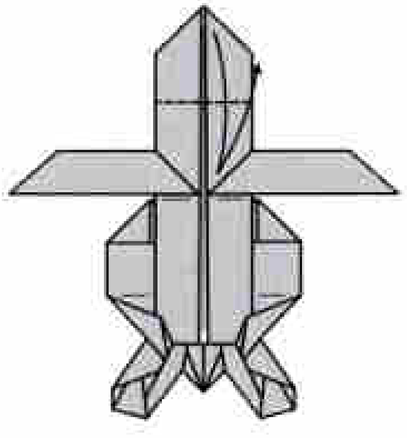
46



47



48



49
Mountain fold and unfold. Use references.

50
Open as far as possible.

51
Pleat through all layers.

52
Close model.

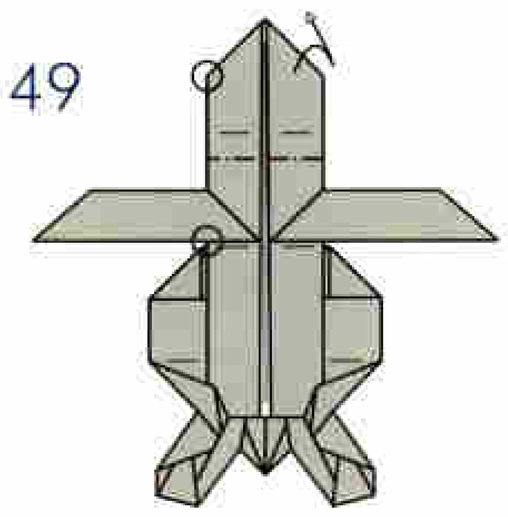
53
Mountain fold the corners.

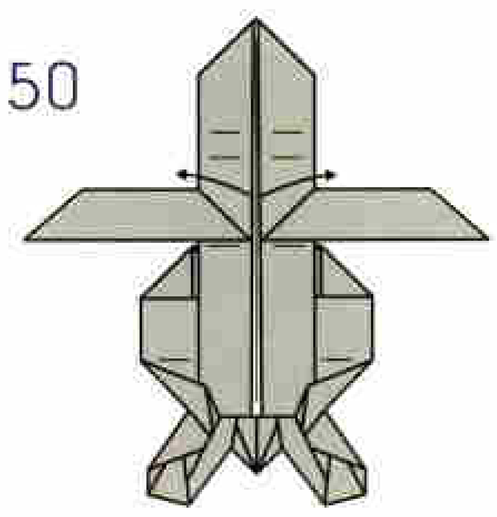
55
Mountain fold the shell.

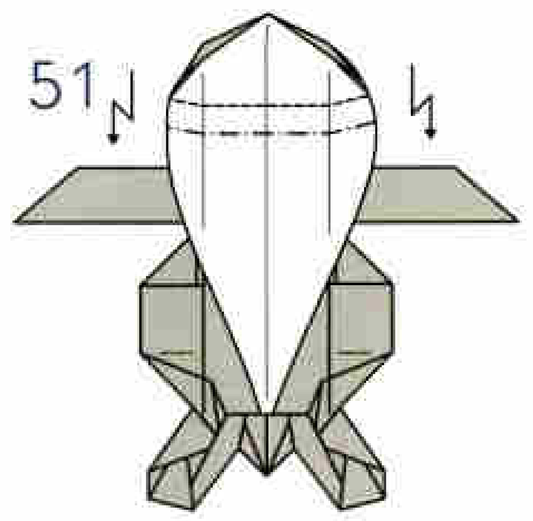
56
Push in and produce the form in step 57.

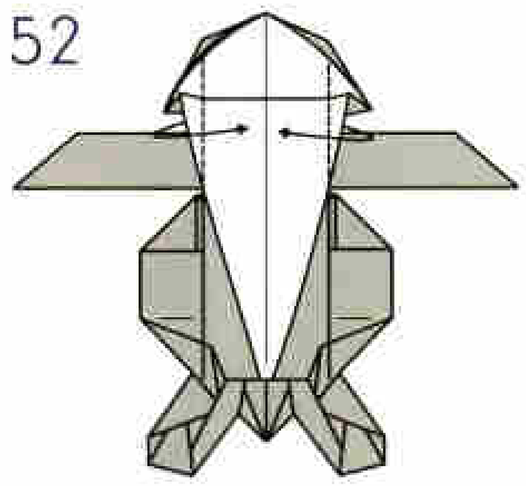
57
Form the head and shape the model.

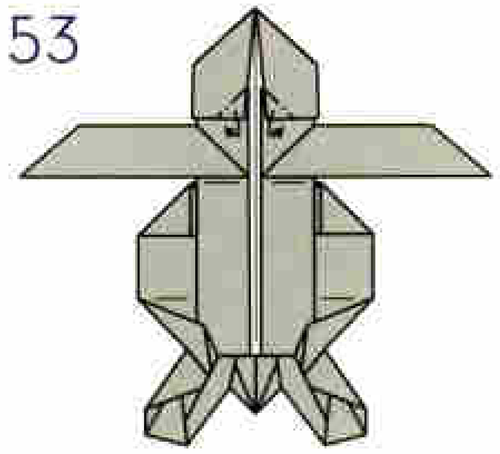
58
Green sea turtle hatchling completed.

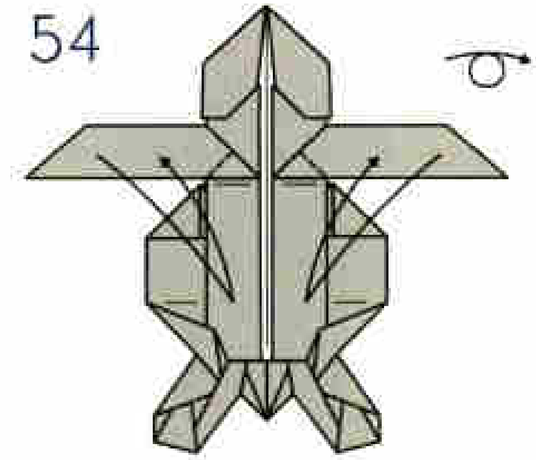


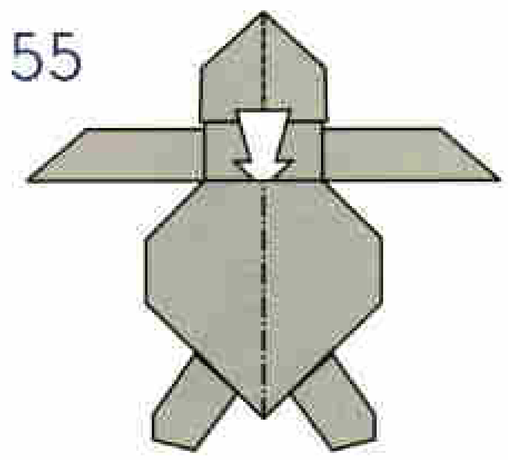


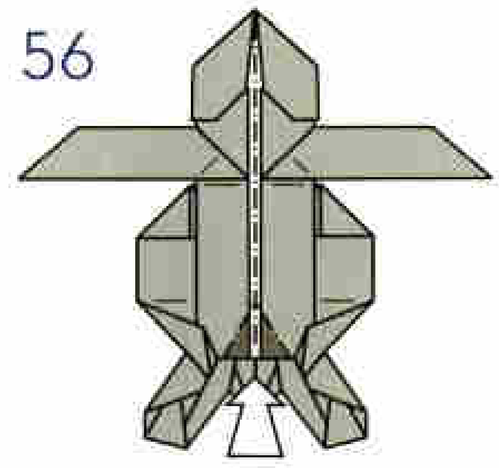


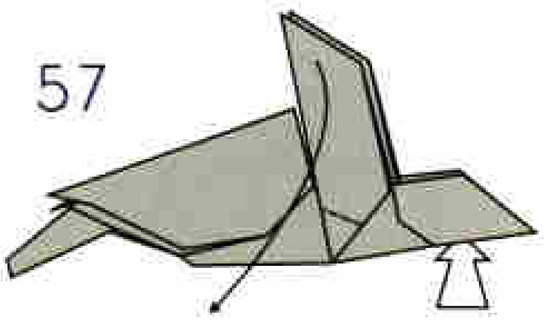


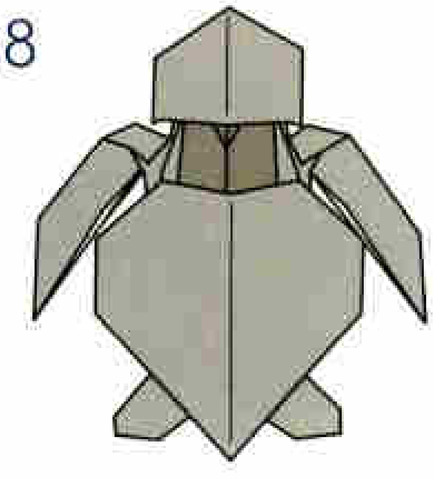


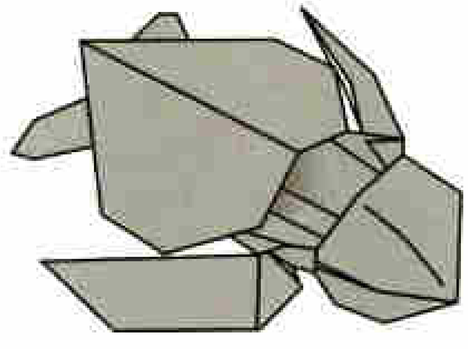










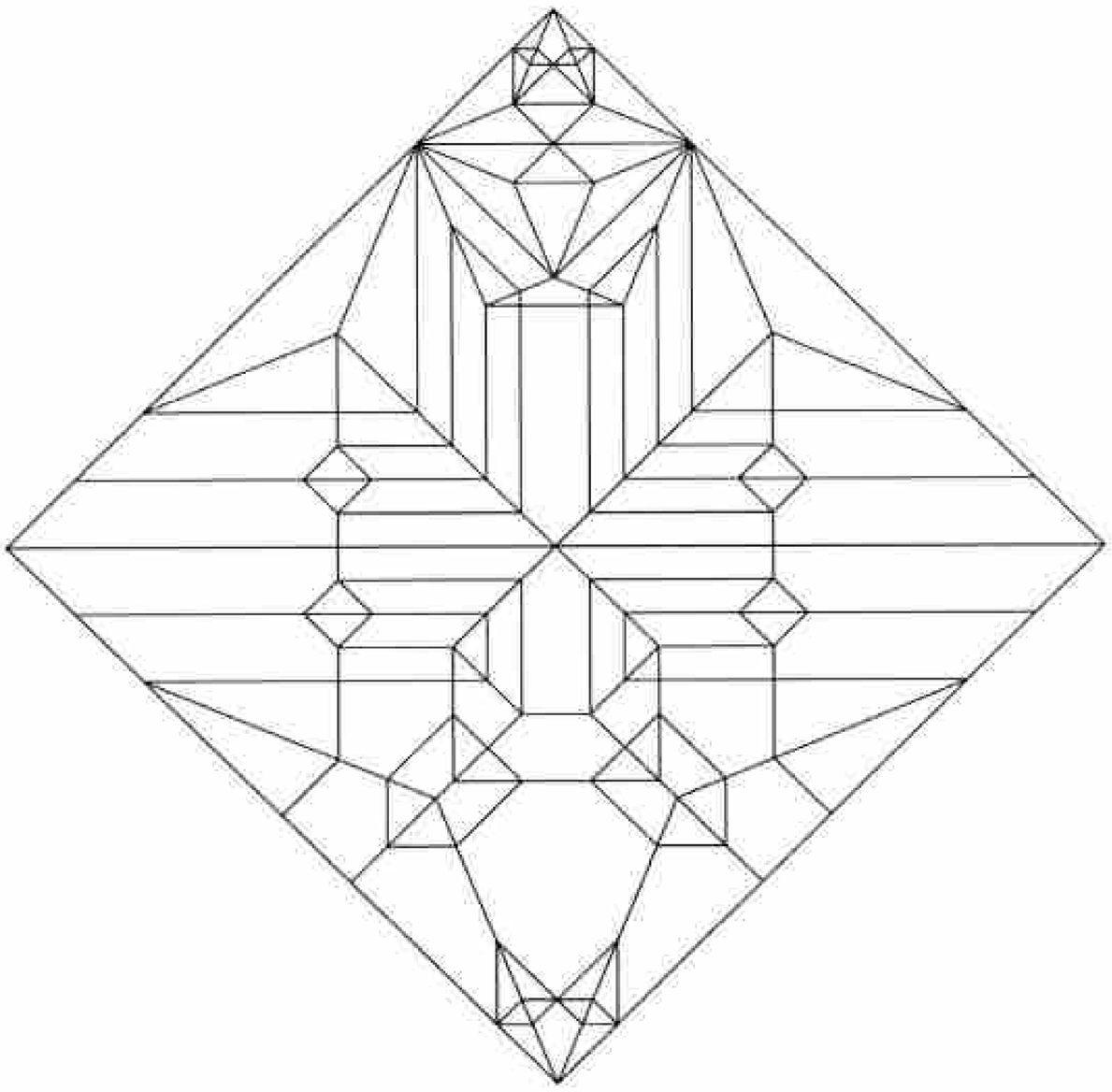




Sea Turtle

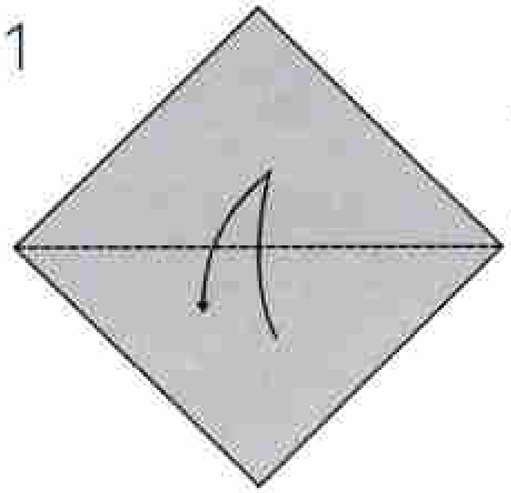
While typically found in warmer waters off Mexico, a small population of green sea turtles resides in Southern California. These green sea turtles can be encountered in San Diego during the warmer months of the year, though it is quite rare. Over the years I have had the fortune of seeing several of these turtles on my dives. Each for a brief moment, but long enough to make a lasting memory.

The sea turtle is based on a preliminary base with the fore flippers on opposite corners and the head in the center of the paper. The head structure is borrowed from one of my first designs in origami. While designing the model I discovered that sea turtles are not in fact green; the common pet red-eared slider is green when young, however.

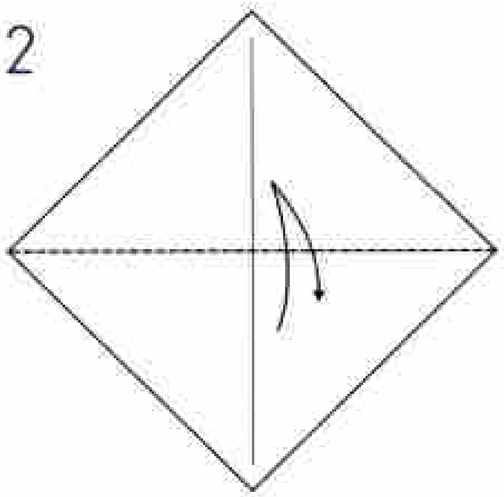




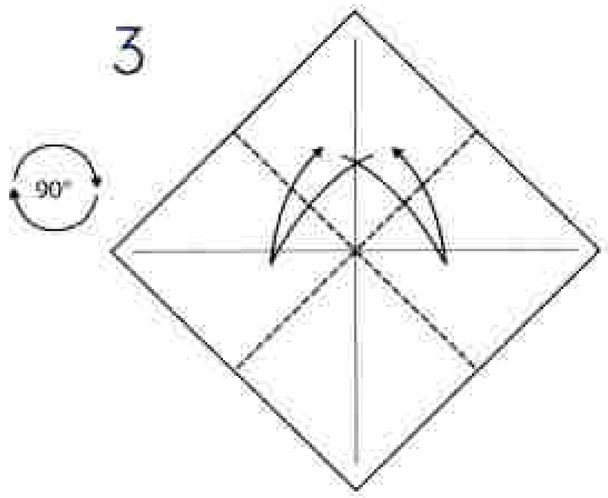
1



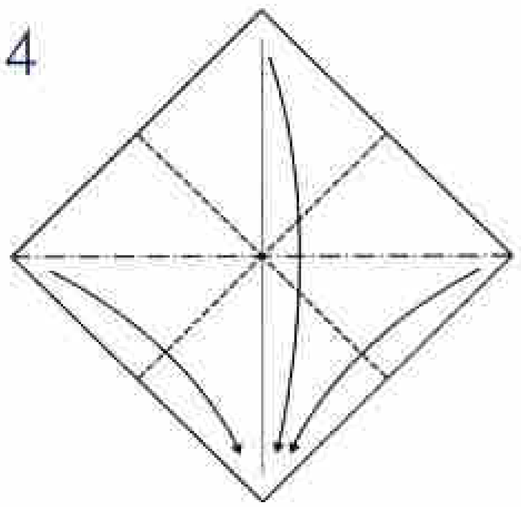
2



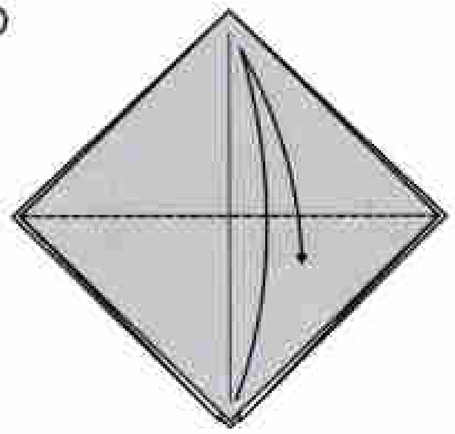
3



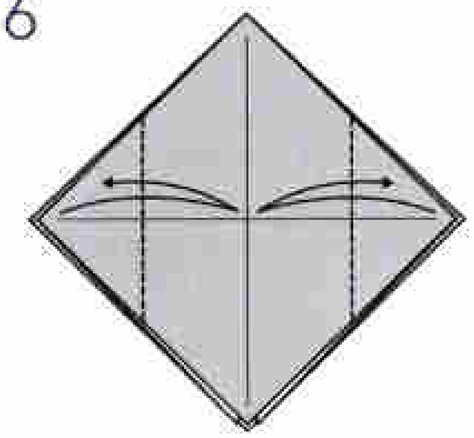
4



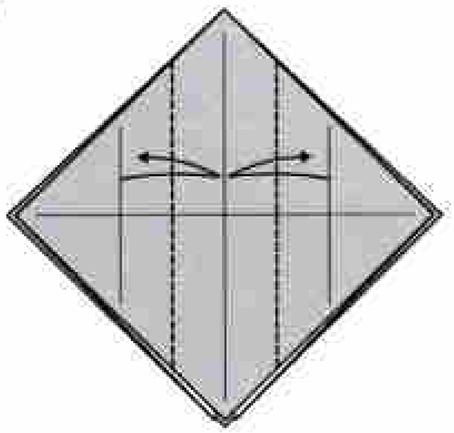
5



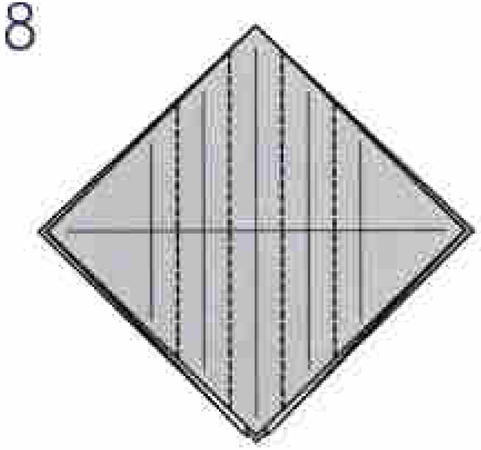
6



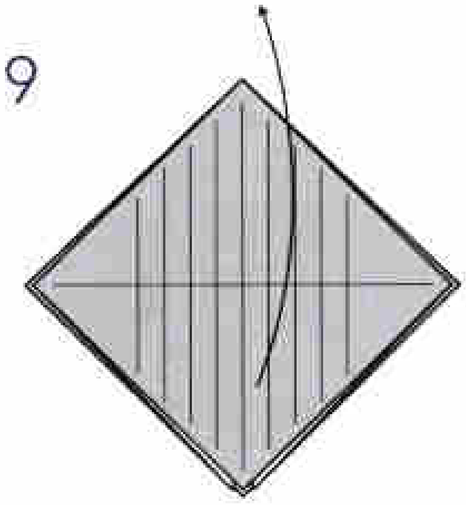
7



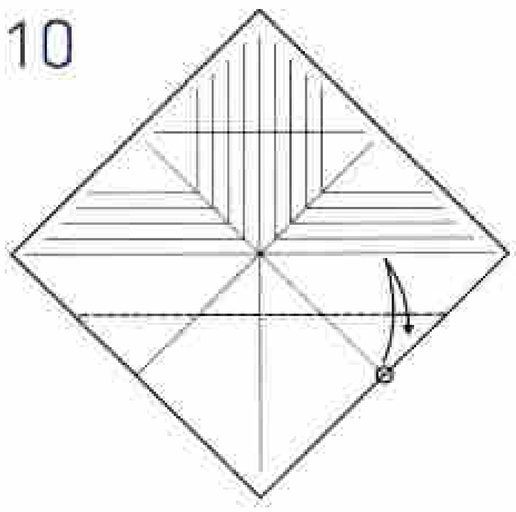
8



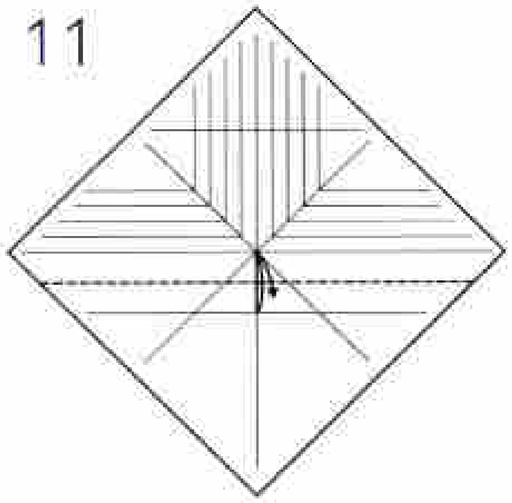
9



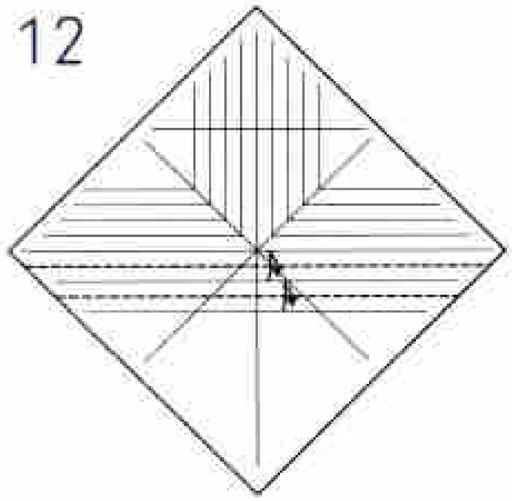
10



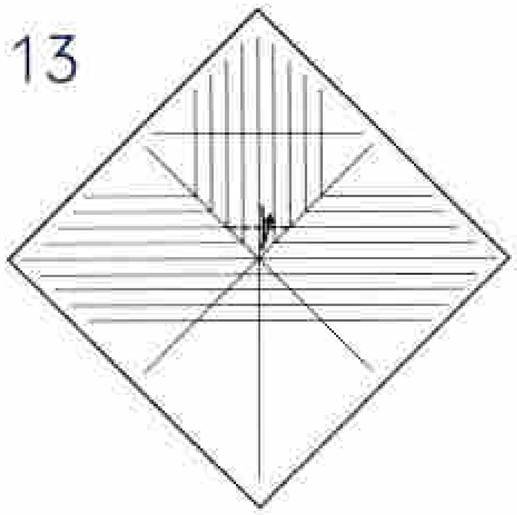
11



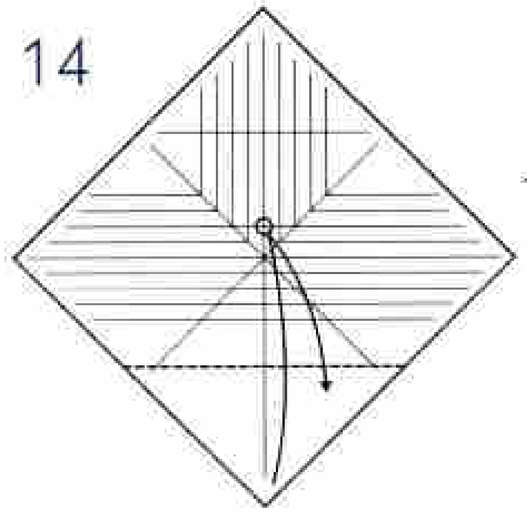
12



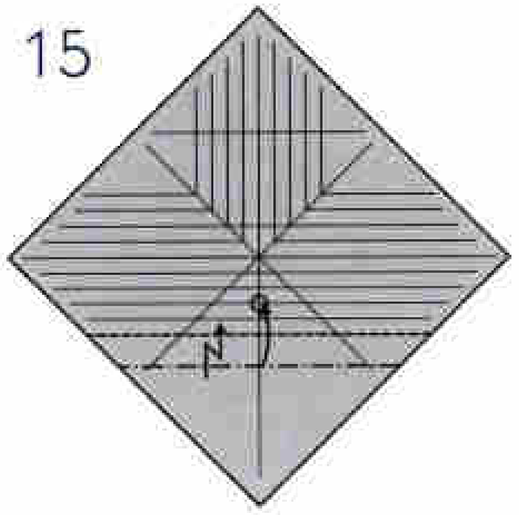
13



14



15



16

Fold and unfold through all layers. Unfold everything.

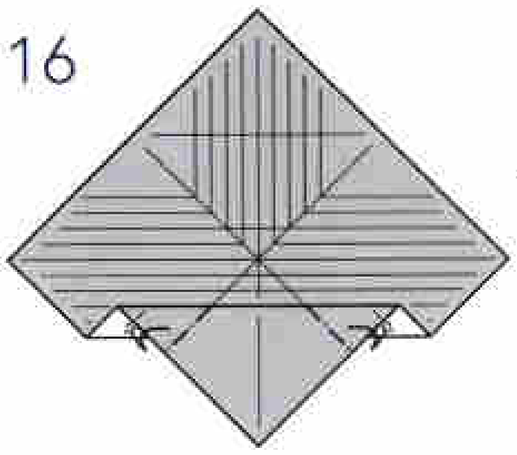
22

Fold and unfold. Use reference point.

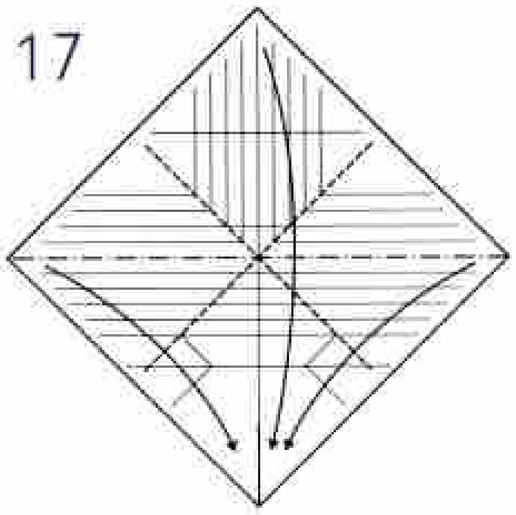
24

Squash.

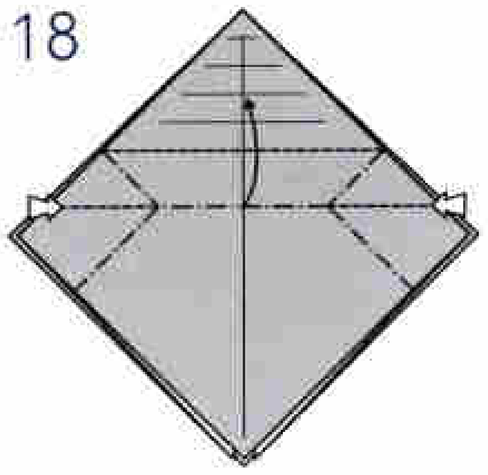
16



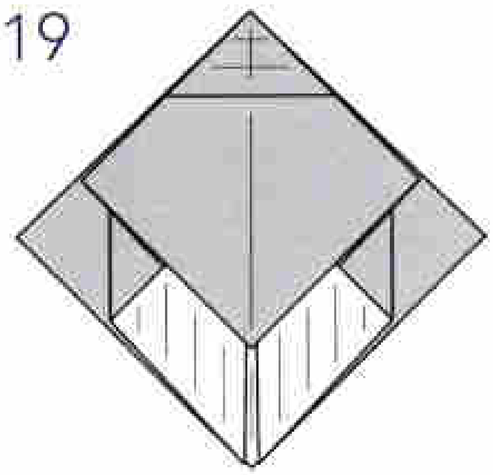
17



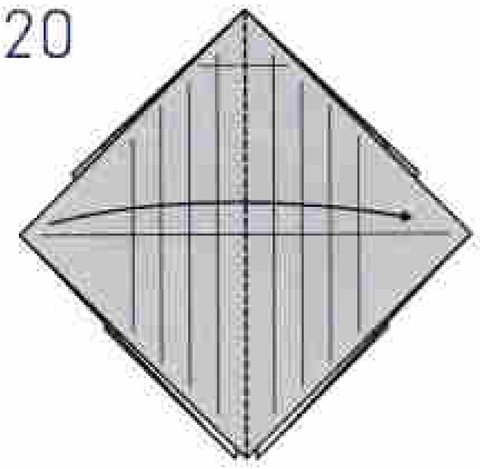
18



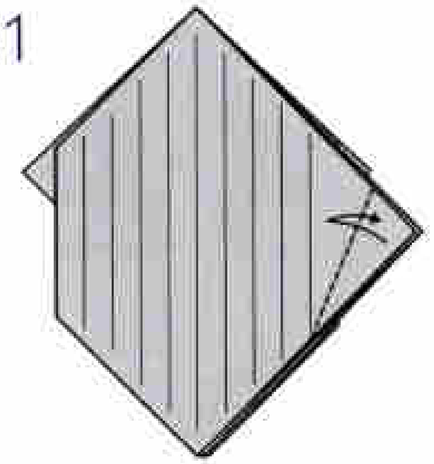
19



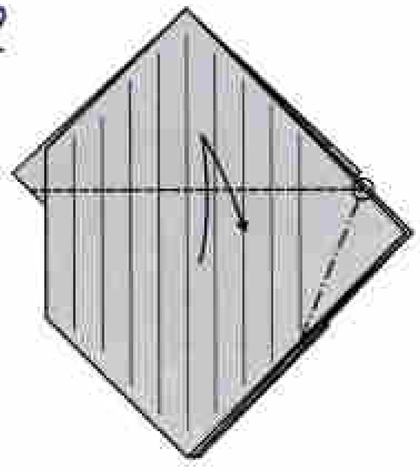
20



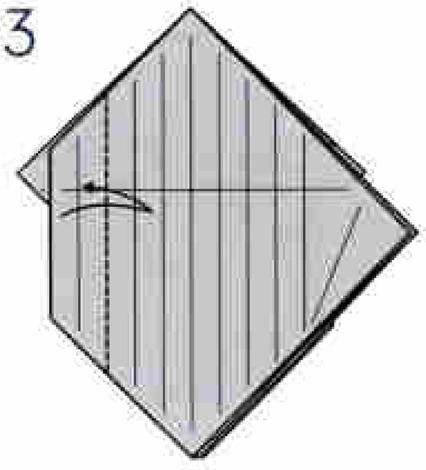
21



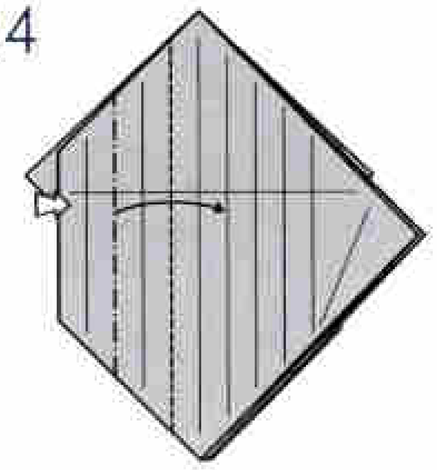
22



23



24



25
Squash completed.

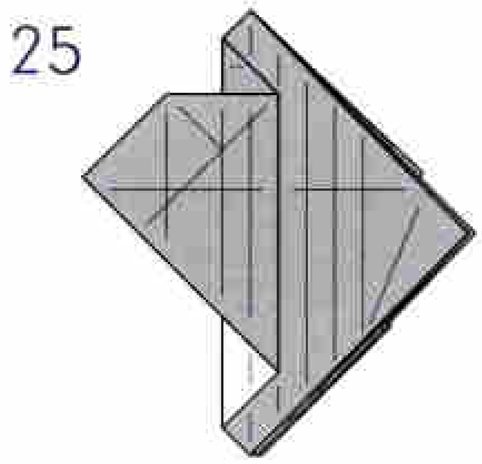
28
Unfold pleat.

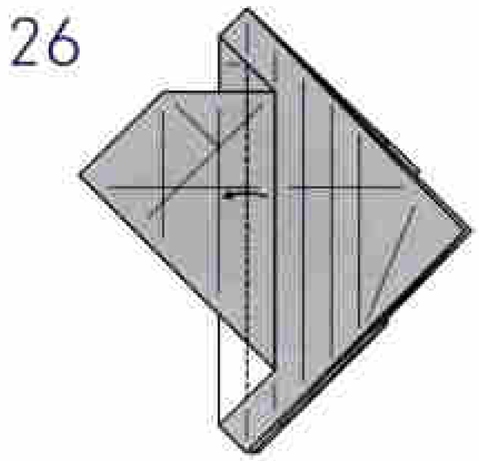
29
Fold and unfold. Use reference point.

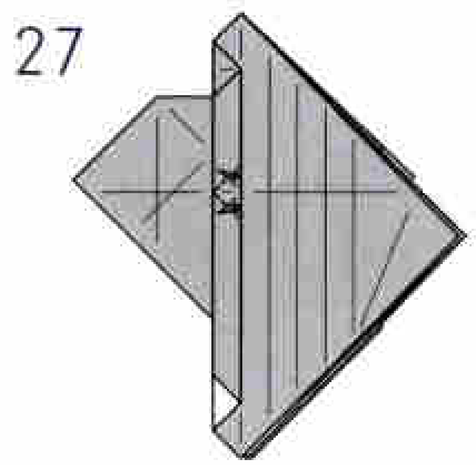
30
Closed sink.

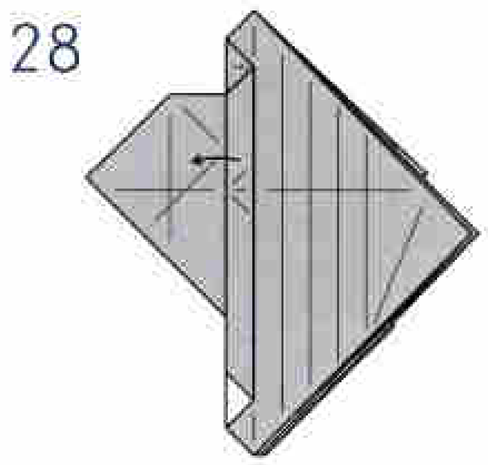
31
Valley fold. Repeat steps 20 to 31 on the right side.

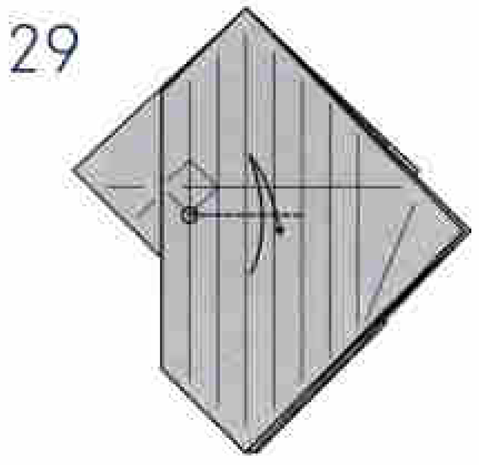
34
Inside reverse folds.

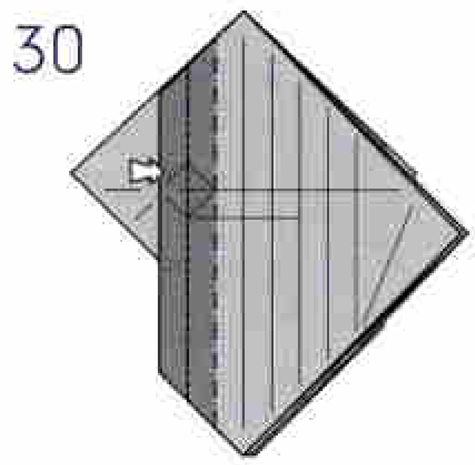


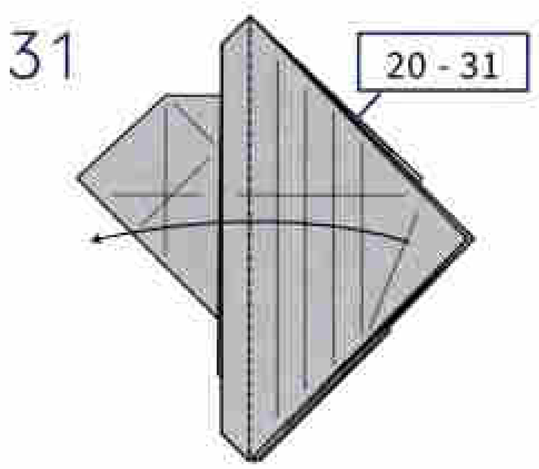


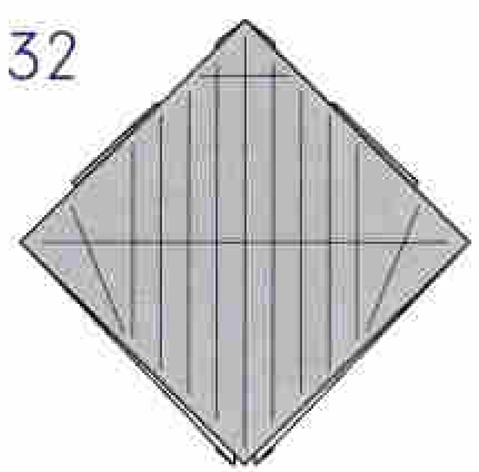


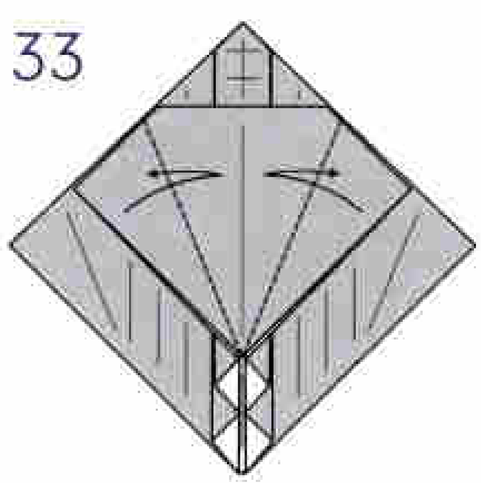


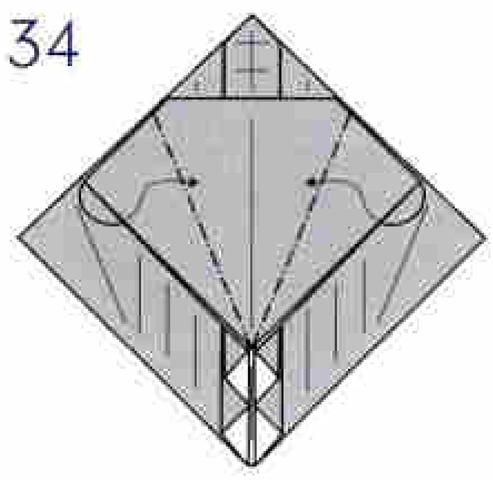


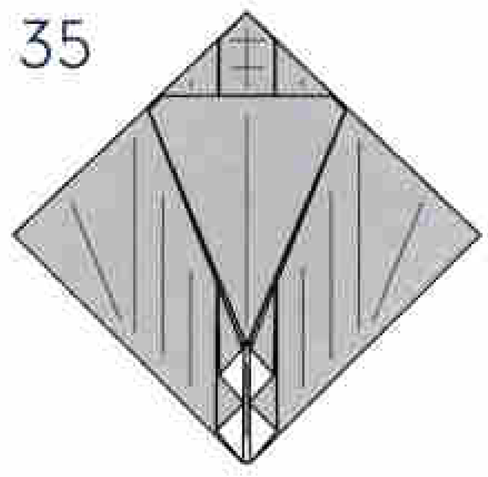


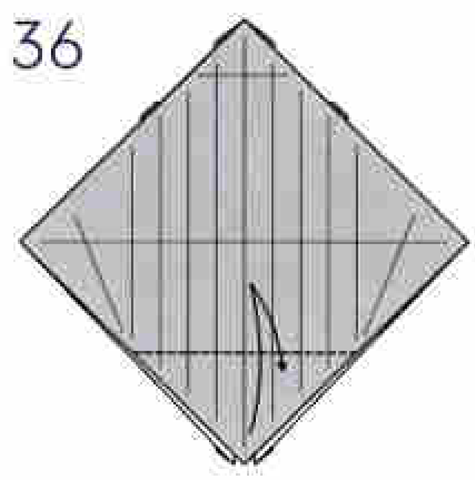




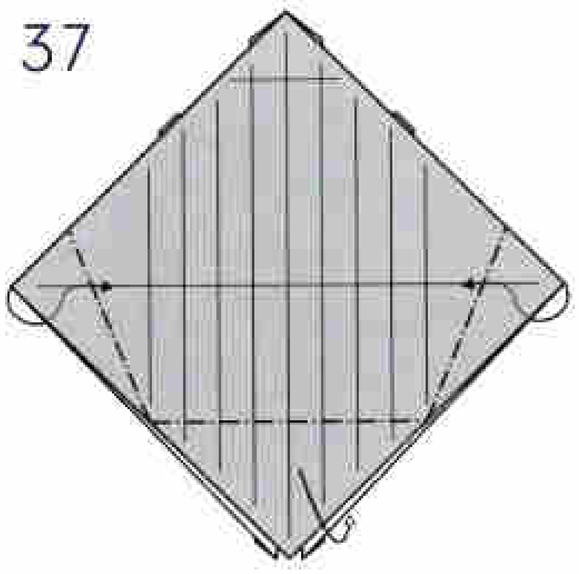




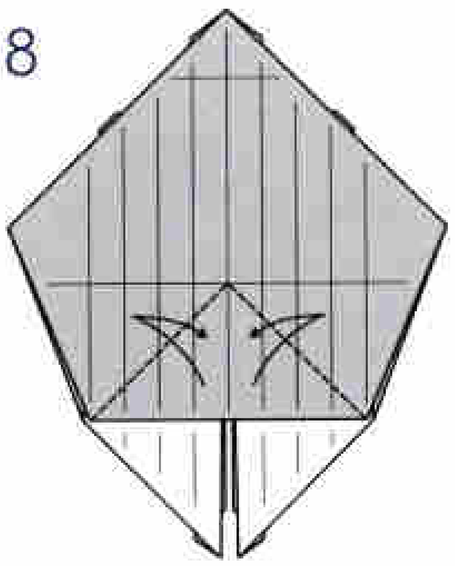




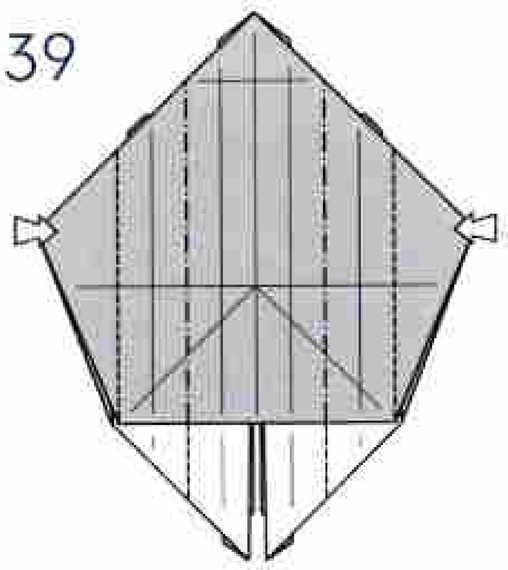
37



38



39



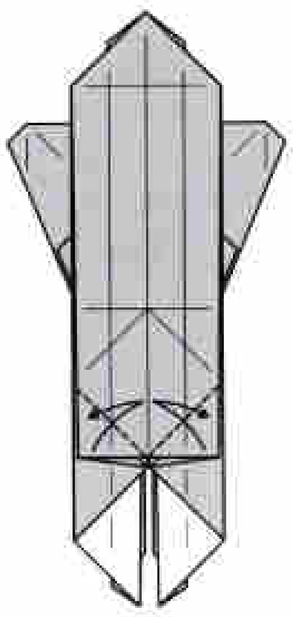
37
Inside reverse folds. Mountain fold.

39
Pleat inside.

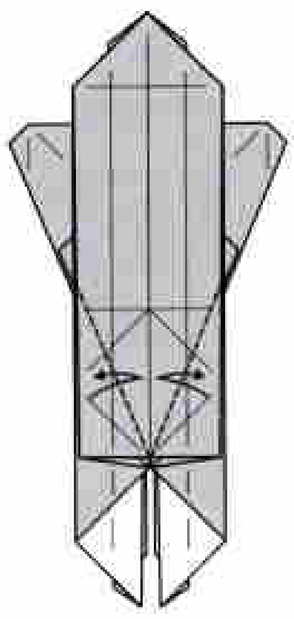
43
Pull out paper.

44
Crimp.

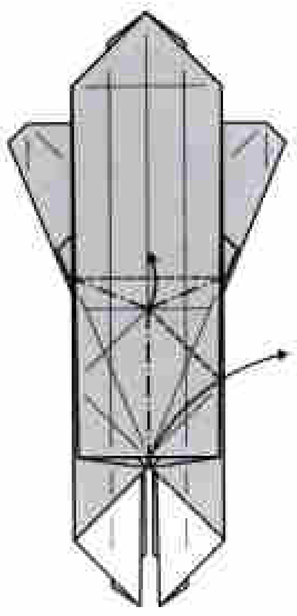
40



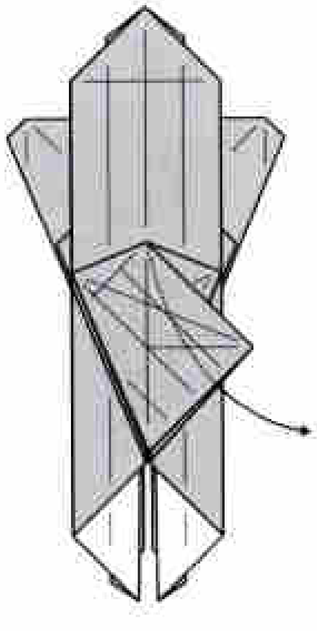
41



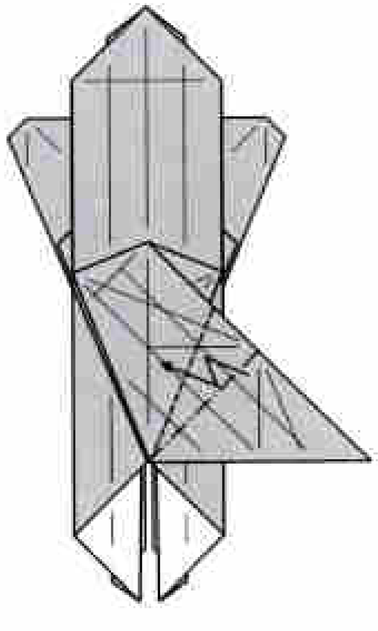
42



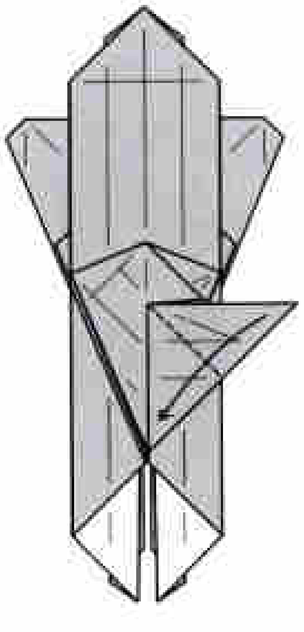
43



44



45

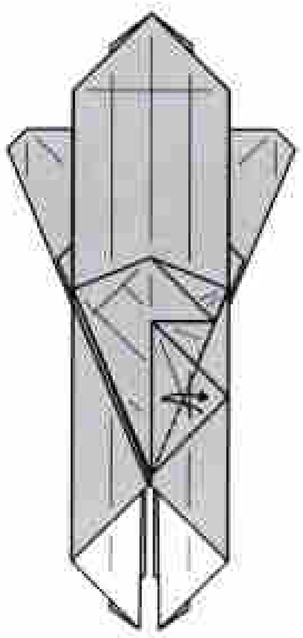


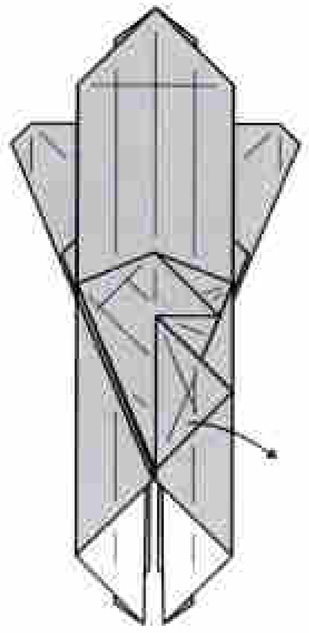
47
Unfold to step 44.

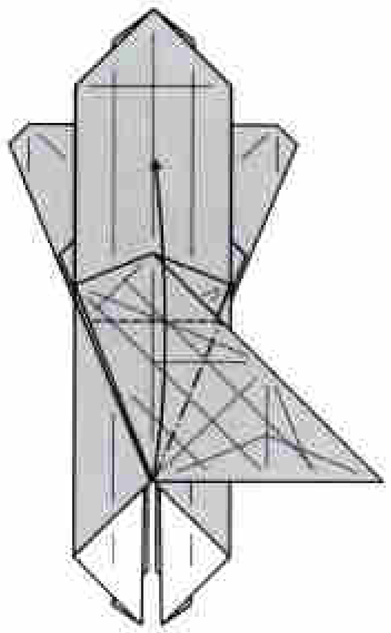
48
Petal fold.

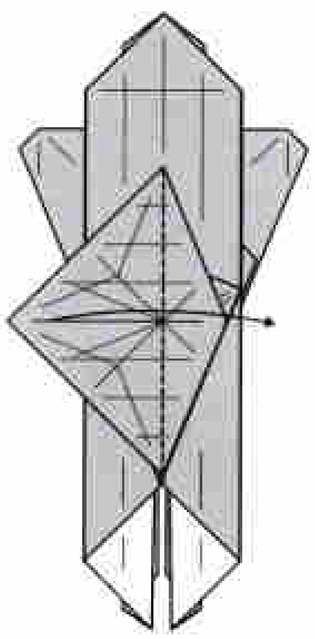
50
Rabbit ear squash.

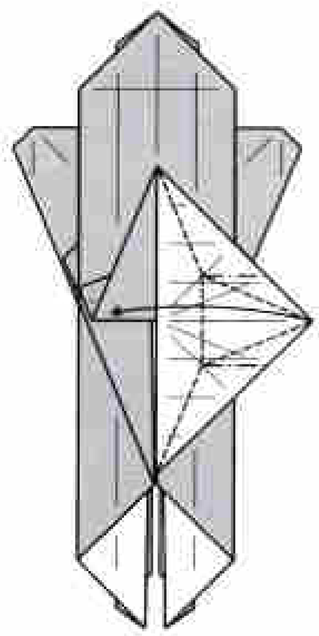
54
Squash.

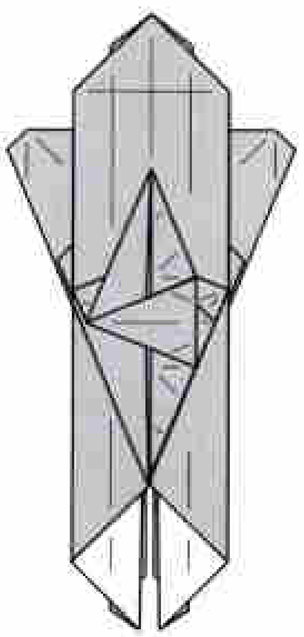
46


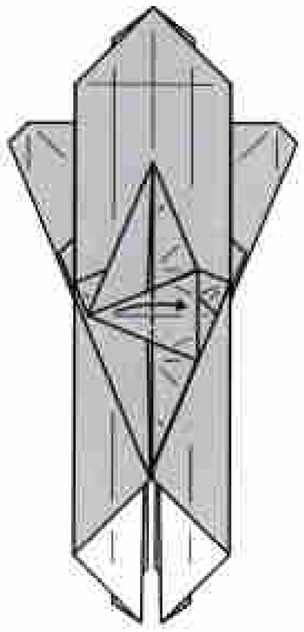
47


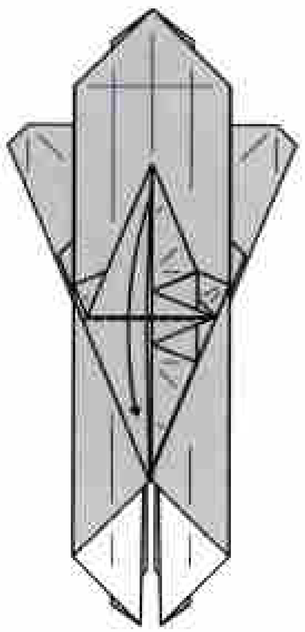
48


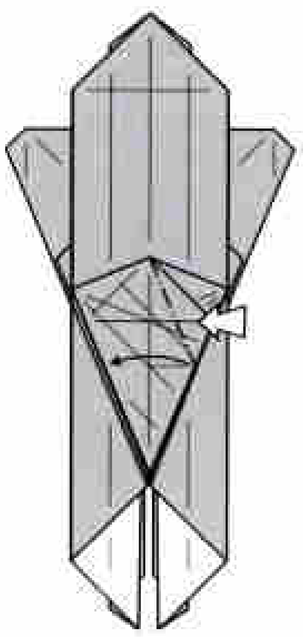
49


50


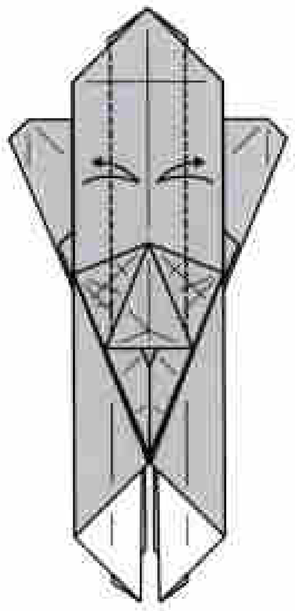
51


52


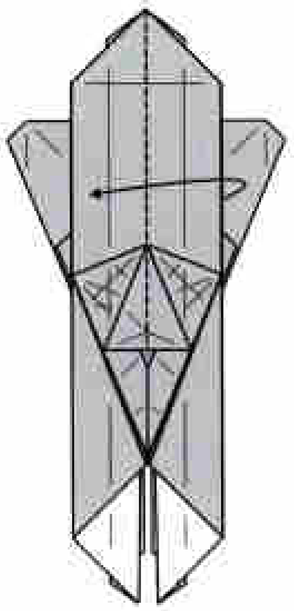
53


54


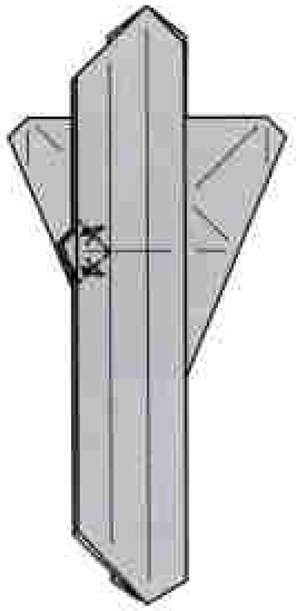
55



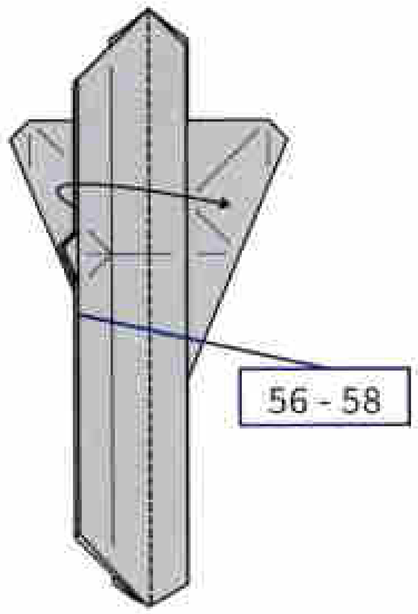
56



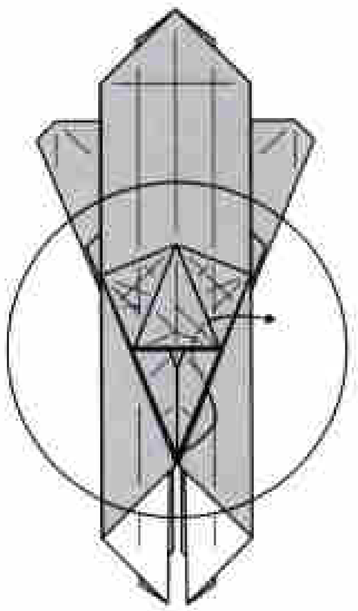
57



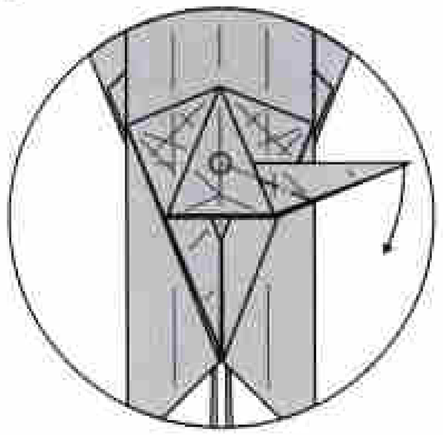
58



59



60



58
Repeat steps 56 to 58 on the left side.

59
Inside reverse fold.

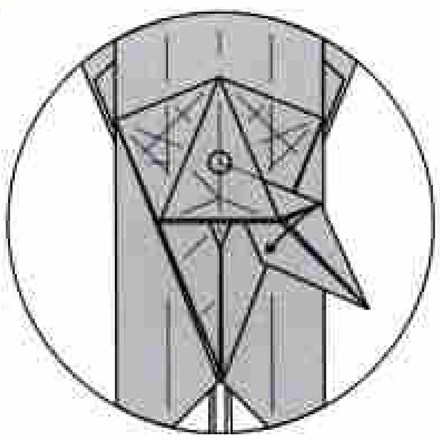
60
Shift the flap. Use reference point.

61
Reverse the top flap.

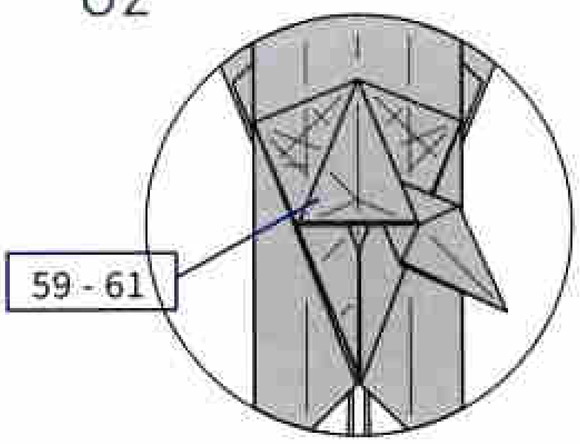
62
Repeat steps 59 to 61 on the left side.

63
Fold and unfold.

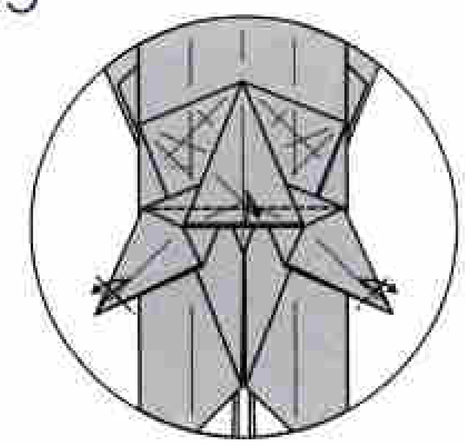
61



62



63



64
Mountain fold and inside reverse folds.

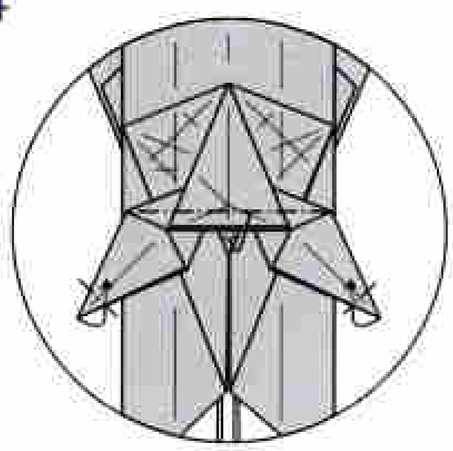
66
Tuck underneath.

67
Wrap the paper around.

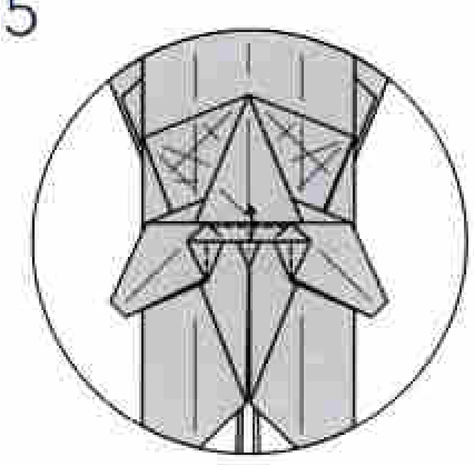
70
Sink. Closed sink at circles.

72
Squash and reverse the middle layers.

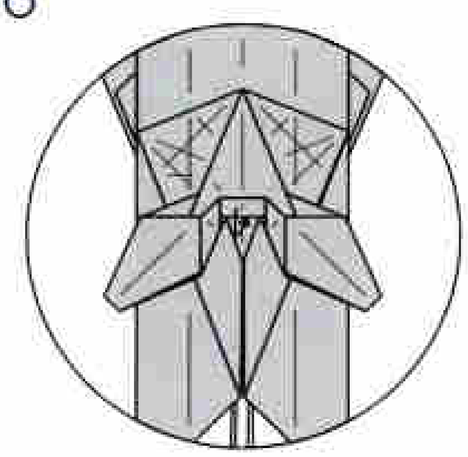
64



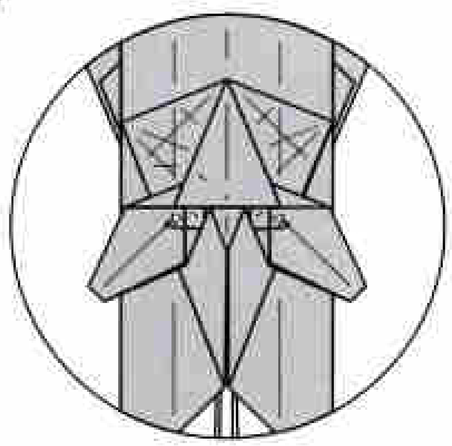
65



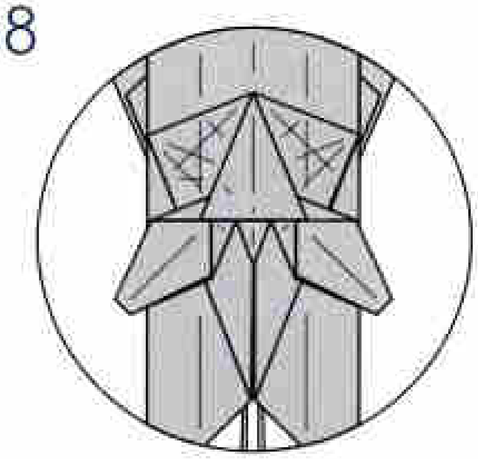
66



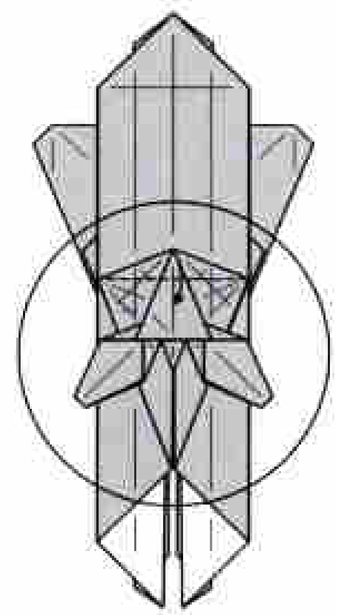
67



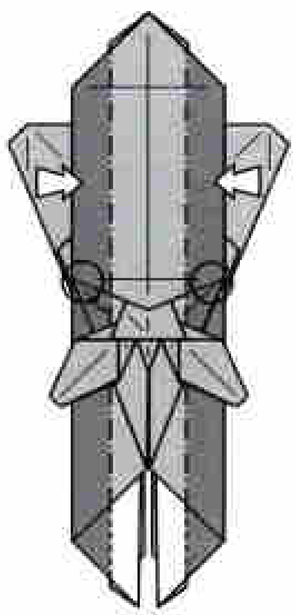
68



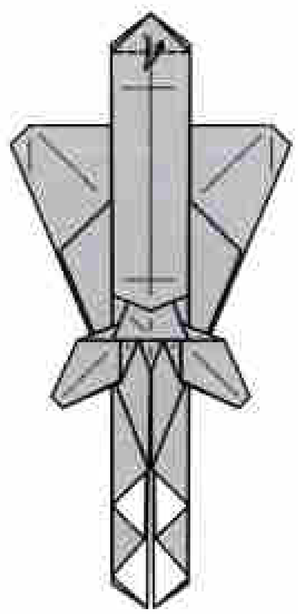
69



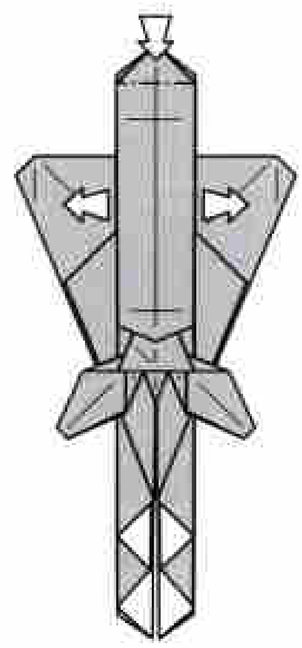
70



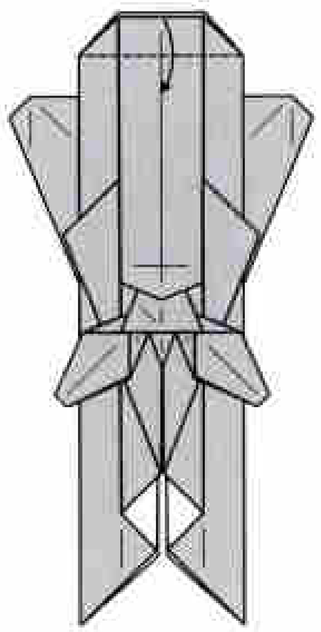
71



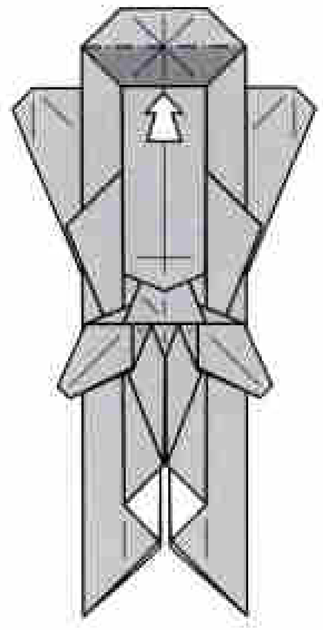
72



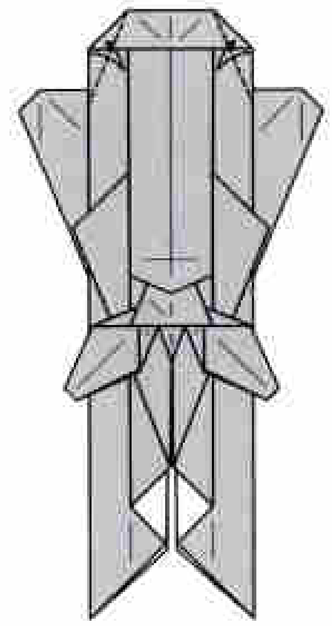
73



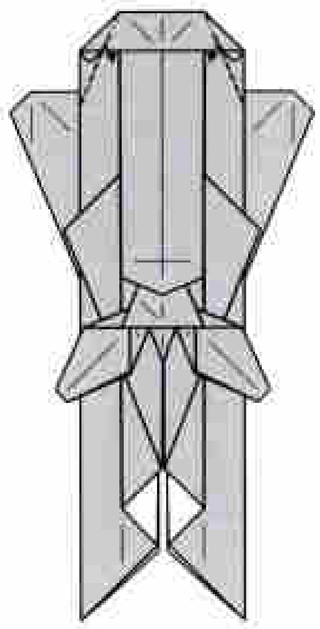
74



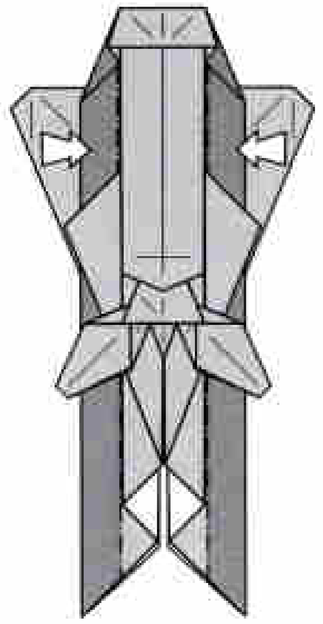
75



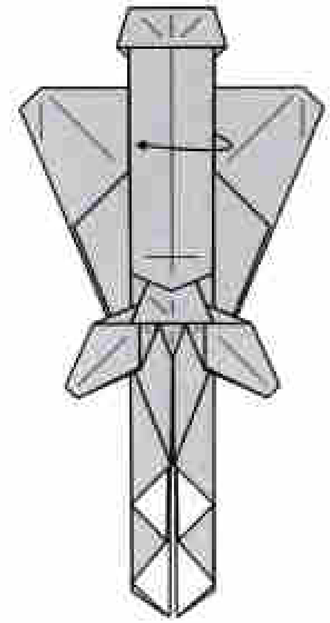
76



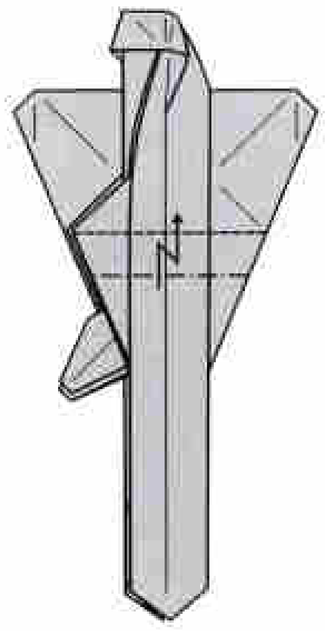
77



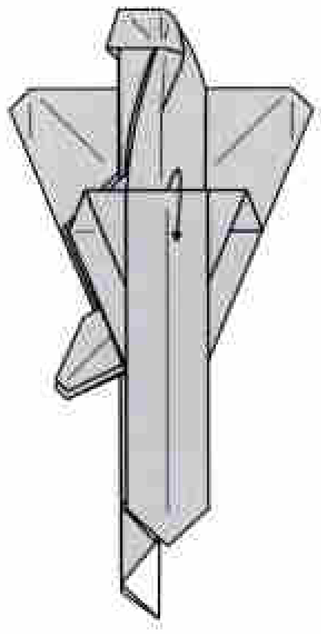
78



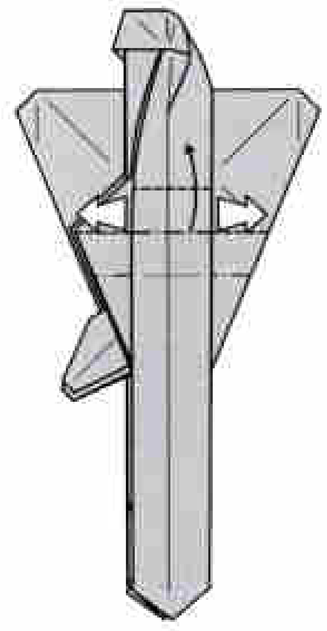
79



80



81



74
Sink.

75
Angle bisectors.
Unfold.

76
Inside reverse
folds.

77
Closed sinks.

79
Pleat one unit.

80
Unfold.

81
Pleat and
extend the top
by collapsing
along existing
creases.

83
Unsink.

84
Sink.

86
Close the model and swivel the flap simultaneously.

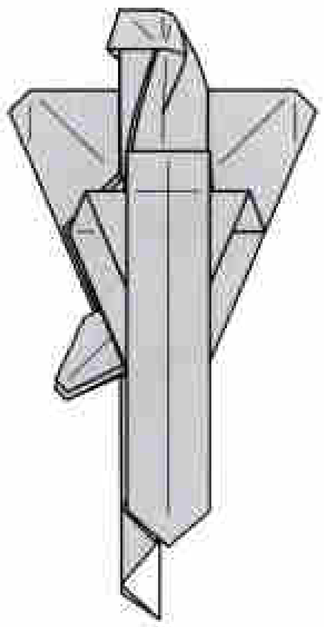
87
Note the reference point. Repeat steps 78 to 86 on the left side.

88
Mountain folds.

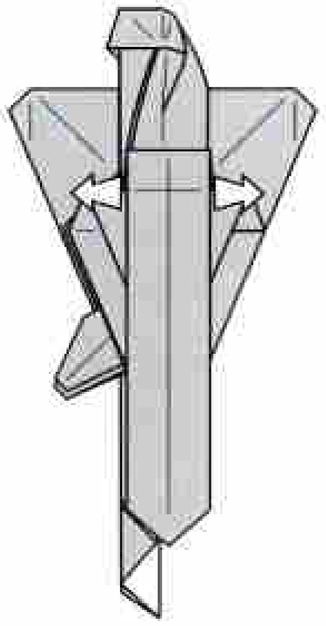
89
Fold and unfold. Use reference points.

90
Closed sinks.

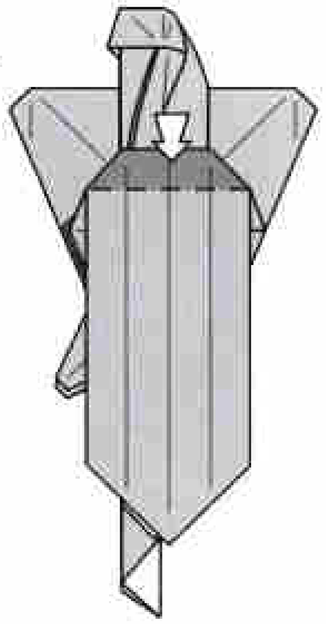
82



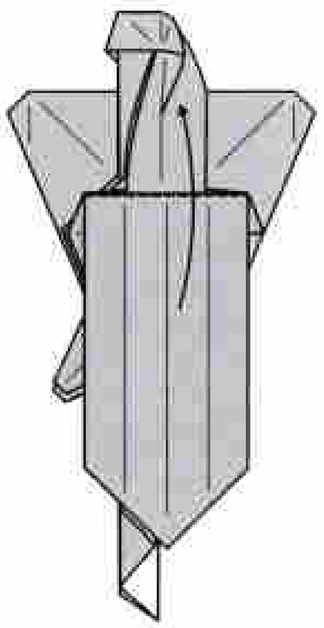
83



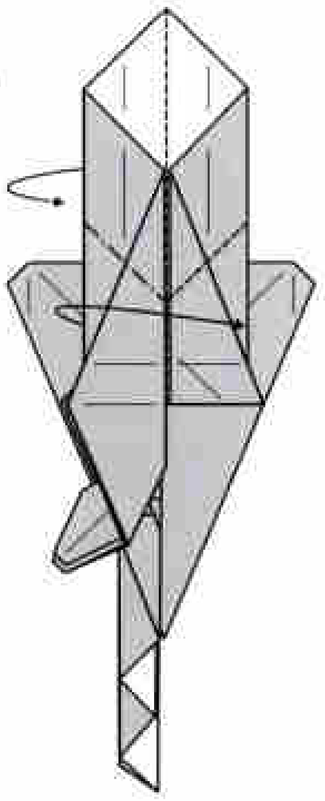
84



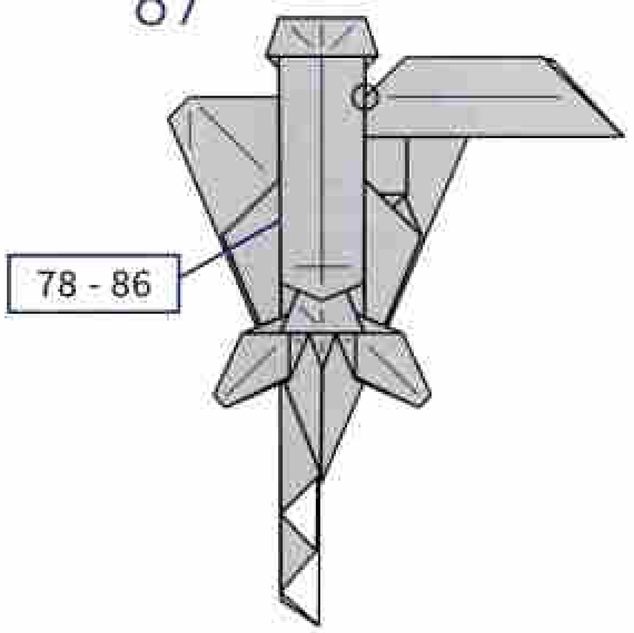
85



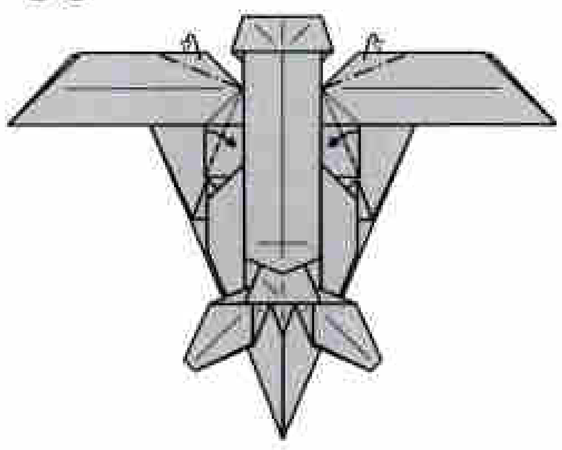
86



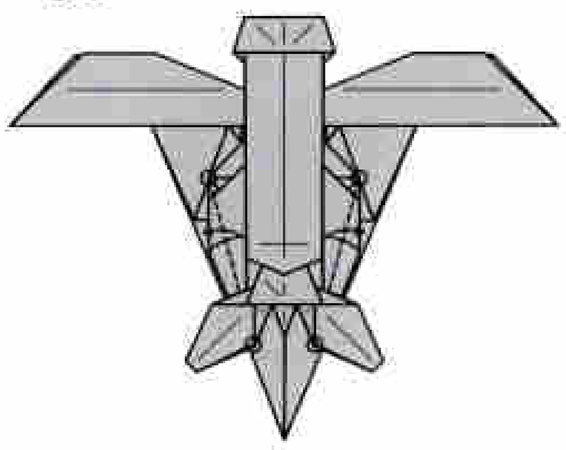
87



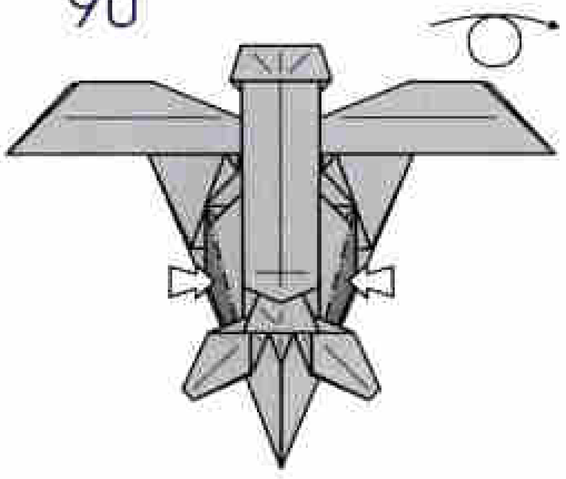
88



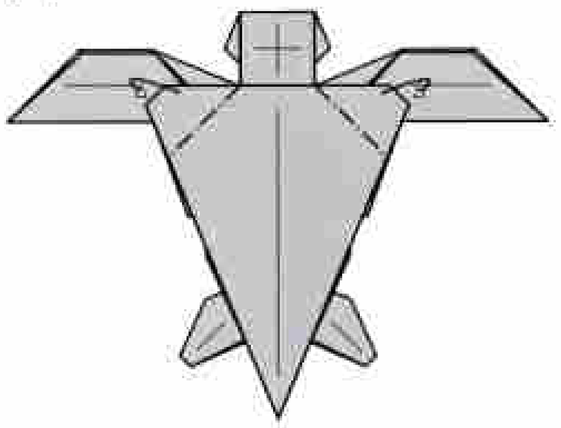
89



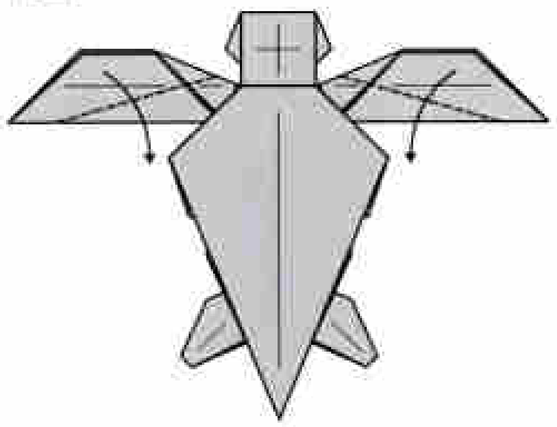
90



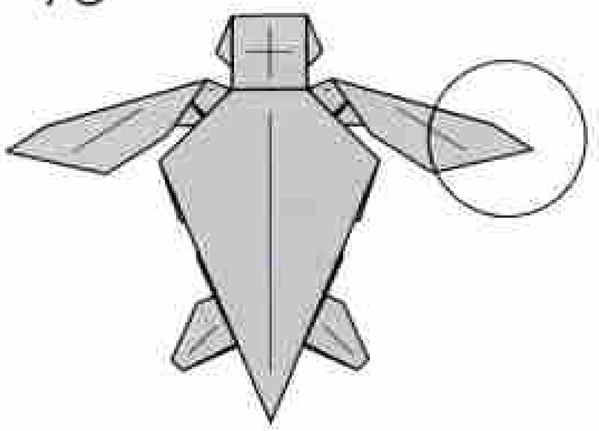
91



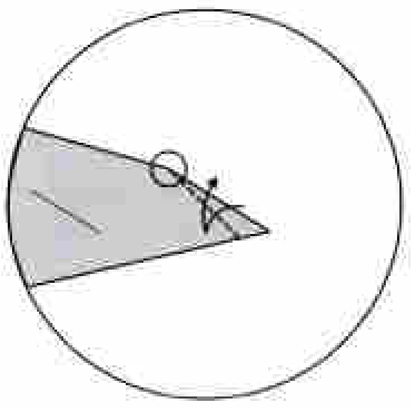
92



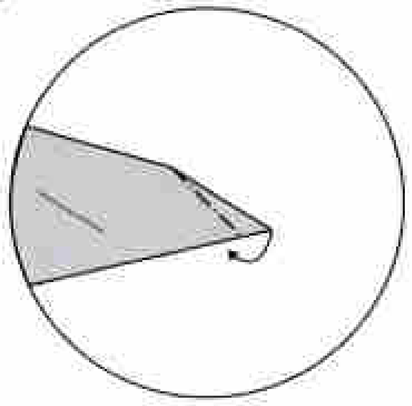
93



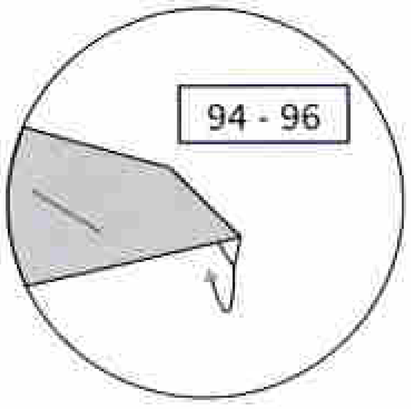
94



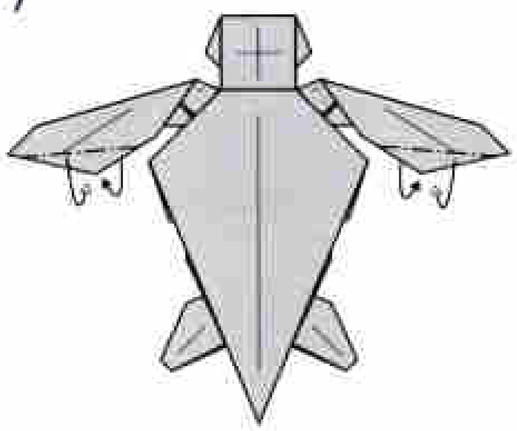
95



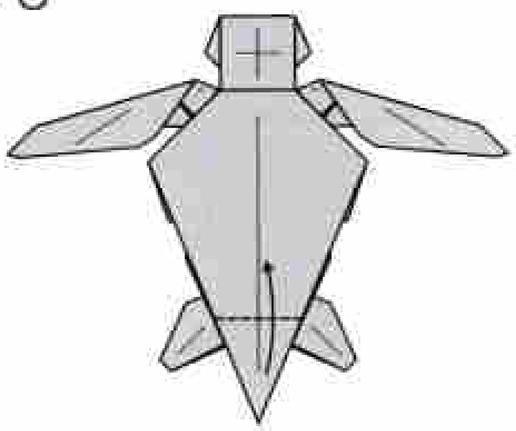
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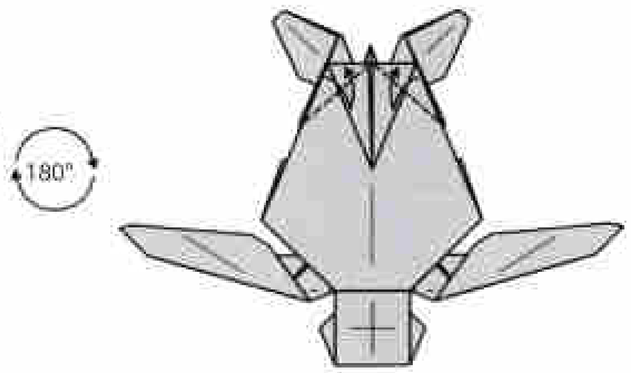
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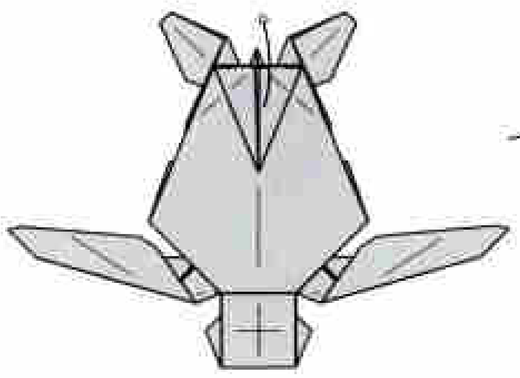
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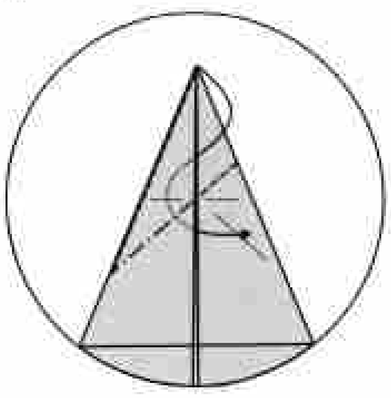
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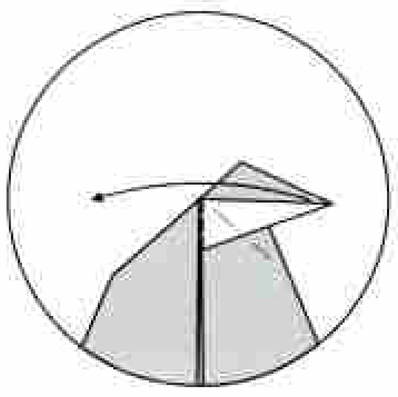
100



101



102



91
Mountain fold behind.

95
Inside reverse fold.

96
Mountain fold the corner inside. Repeat steps 94 to 96 on the left side.

97
Fold inside.

98
Valley fold to expose the tail.

101
Inside reverse fold.

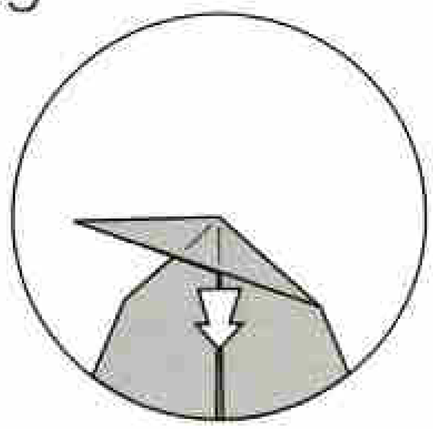
103
Pull out paper.

106
Tuck under.

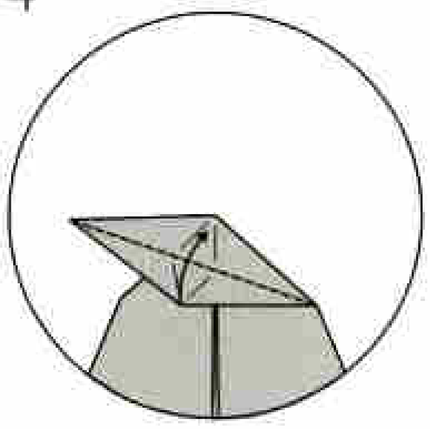
109
Shape.

110
Sea turtle
completed.

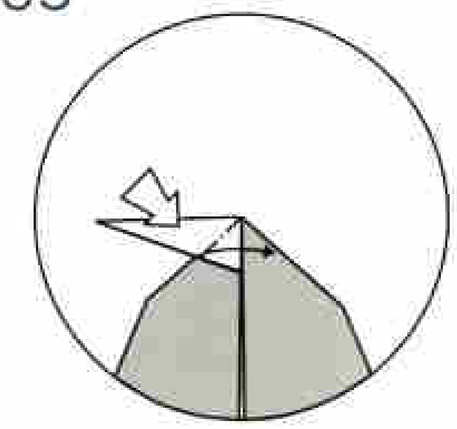
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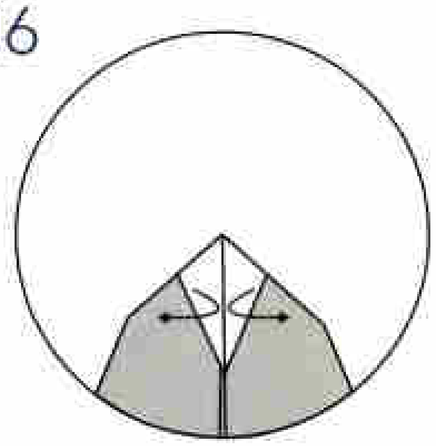
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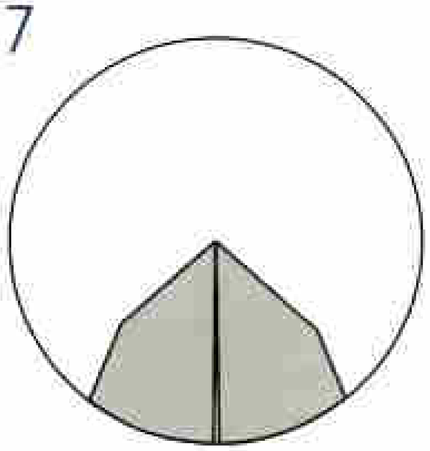
105



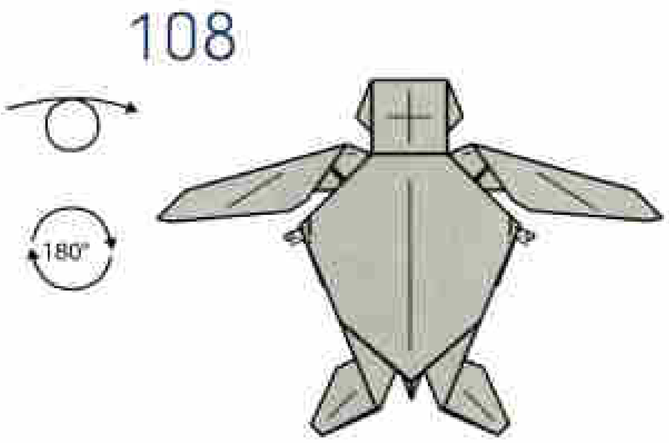
106



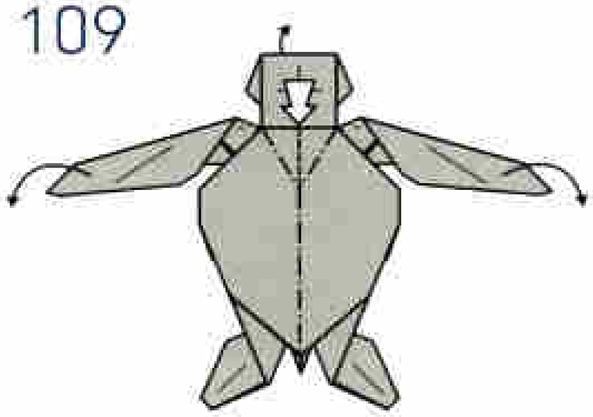
107



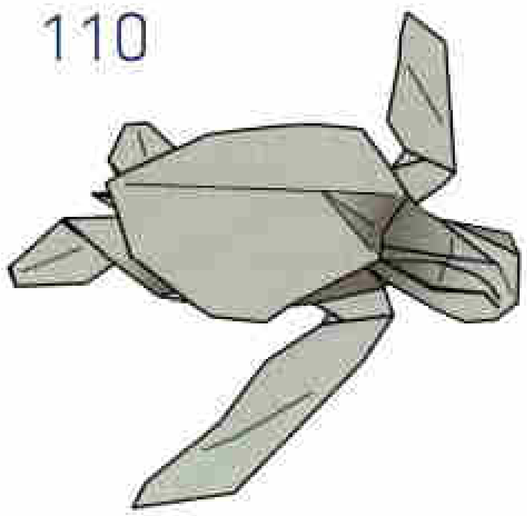
108



109



110



The Three Steps of Folding

PRECREASING

Precreasing is the first fundamental step of folding origami. Without precreasing, we would not be able to collapse the model. We begin by performing a set of initial creases, each crease dependent on the previous. These creases are folded in a specific direction—mountain or valley—so that there is minimal reversing of folds later on. The end result of the precreasing step is the uncollapsed square sheet of paper with a set of creases.

During the folding sequence we mainly do valley folds, substituting mountain folds by flipping the paper over to do more valley folds. We do this because mountain folds are imprecise to fold, and precision is crucial in folding complex origami.

COLLAPSING

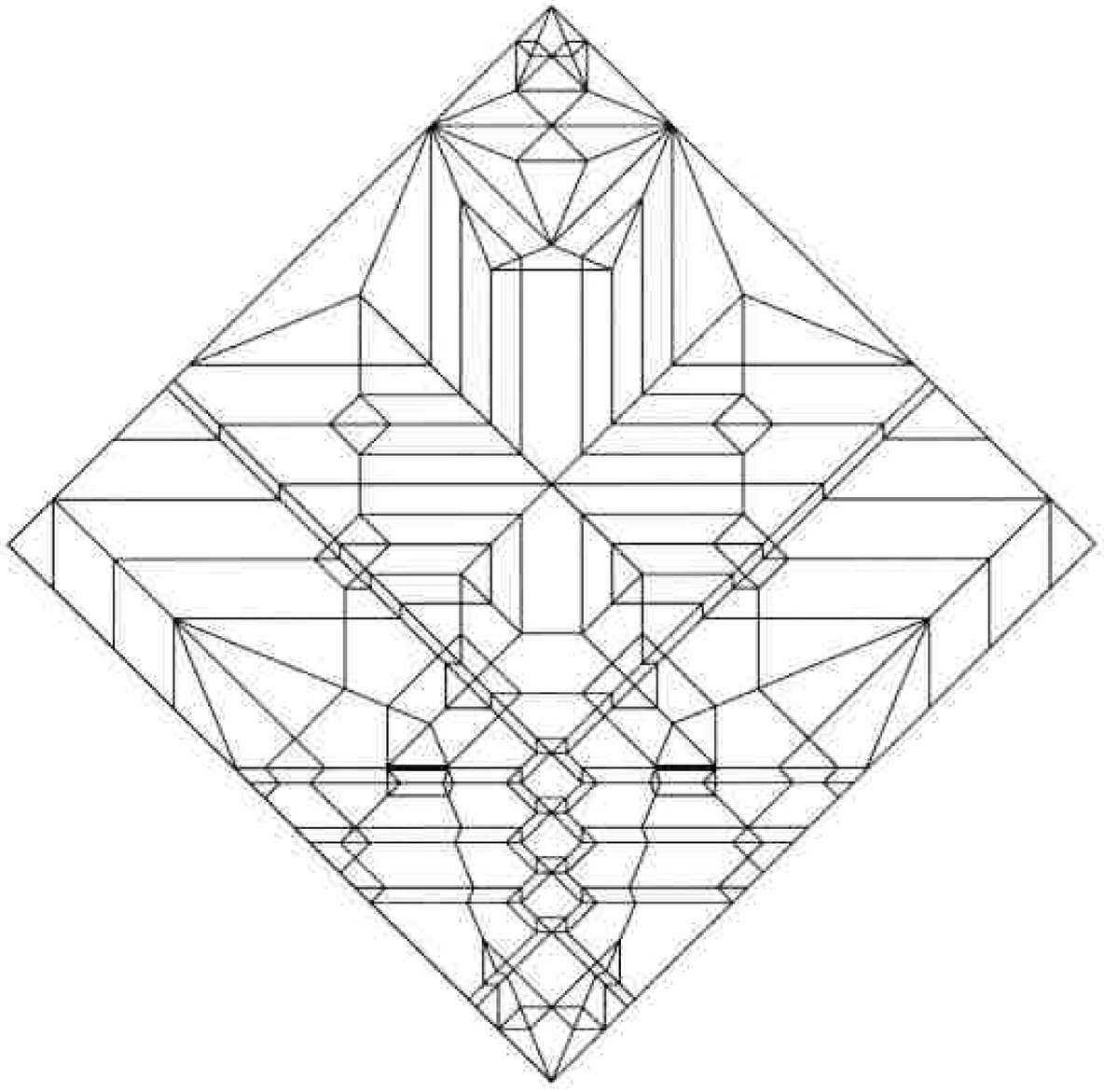
The next step, collapsing, ends in an intermediate form of the model which we call the base. This is generally the bulk of the folding process. In collapsing, a series of folds transforms the precreased sheet of paper into a basic figure with the correct distribution of flaps, layers, and faces. In most cases, the finished base lies flat.

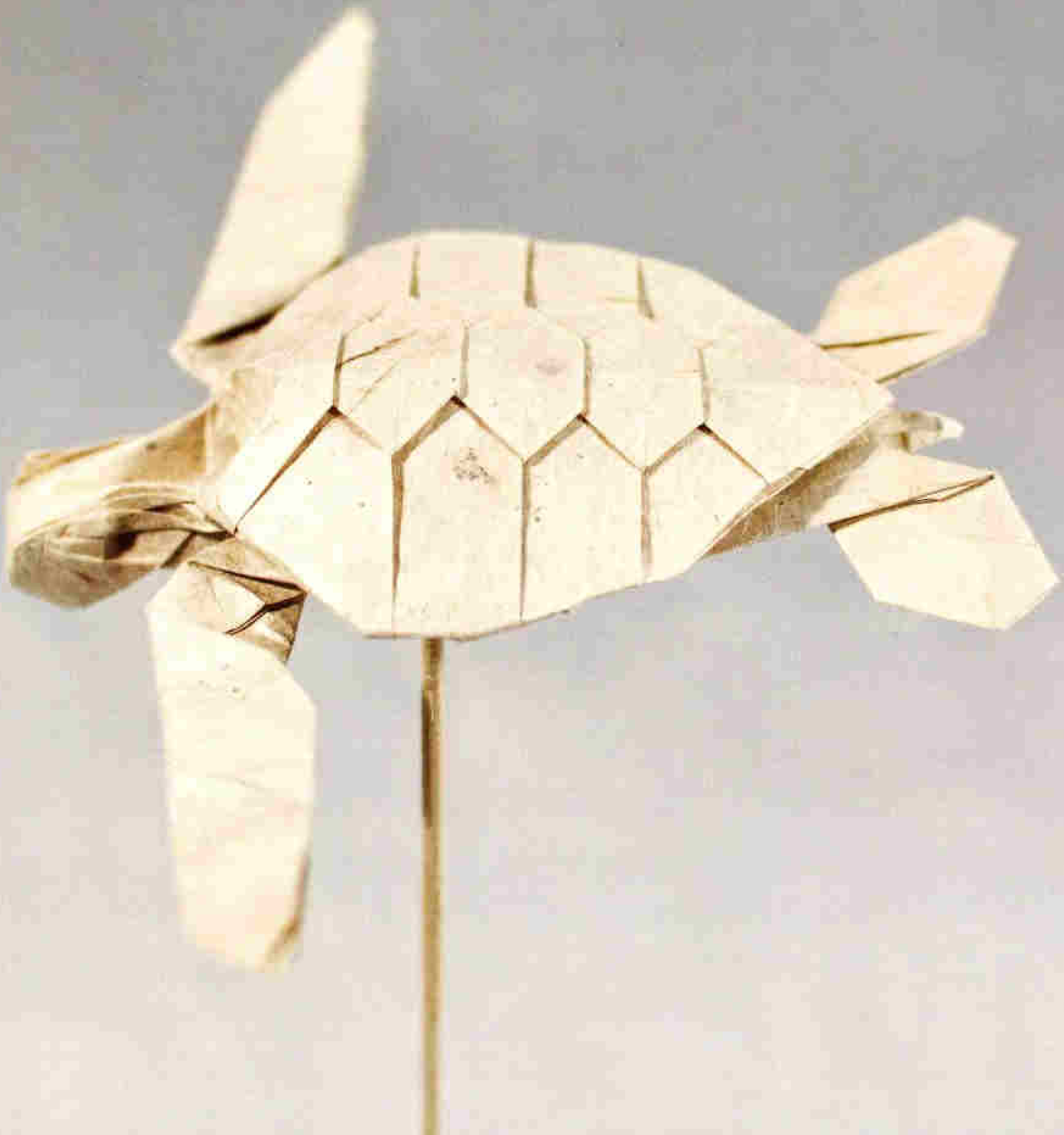
SHAPING

The last step is shaping. Shaping adds details to each flap, layer, or face created during the collapsing stage. It gives expression to the folded model, turning the flat base into a three-dimensional form. Depending on the design style—boxpleating or 22.5° for example—there may be minimal or lots of shaping required. The diagrams in this book provide basic shaping methods for each model. You can decide what you want the model to look like.

Sea Turtle Shell

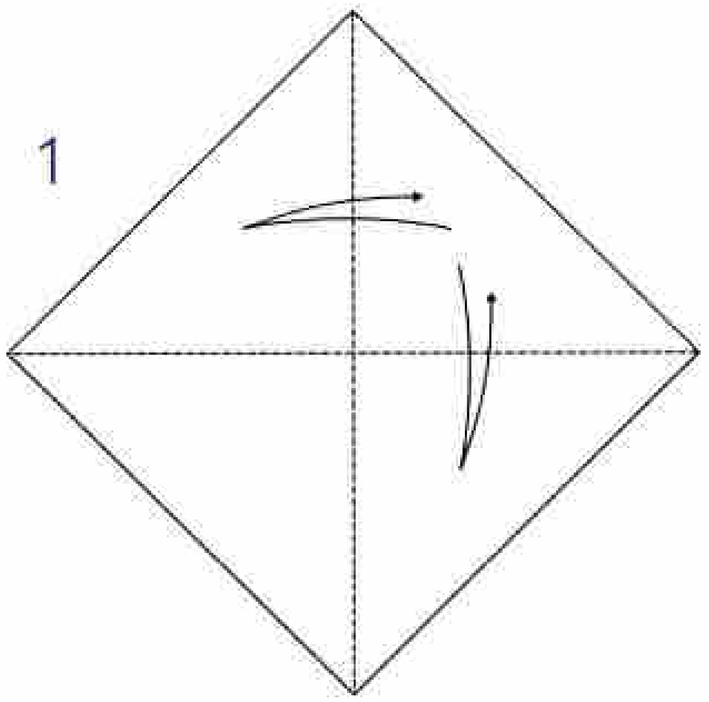
Realizing that a shell graft was possible for the sea turtle model, I designed a tessellated shell graft that required no change in the original base. This required a bit of adjusting to position the shell pattern in the correct location. I excluded the marginal scutes on the carapace to keep the model from becoming overly complicated.

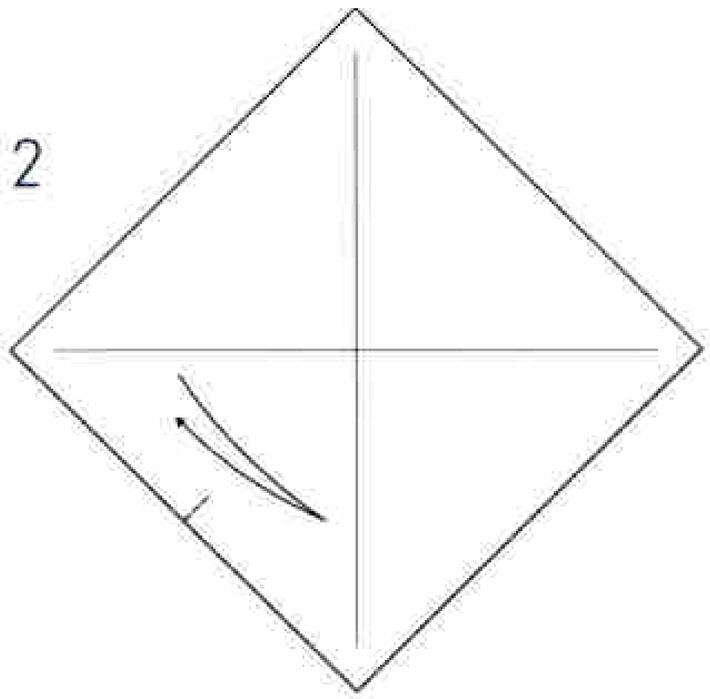


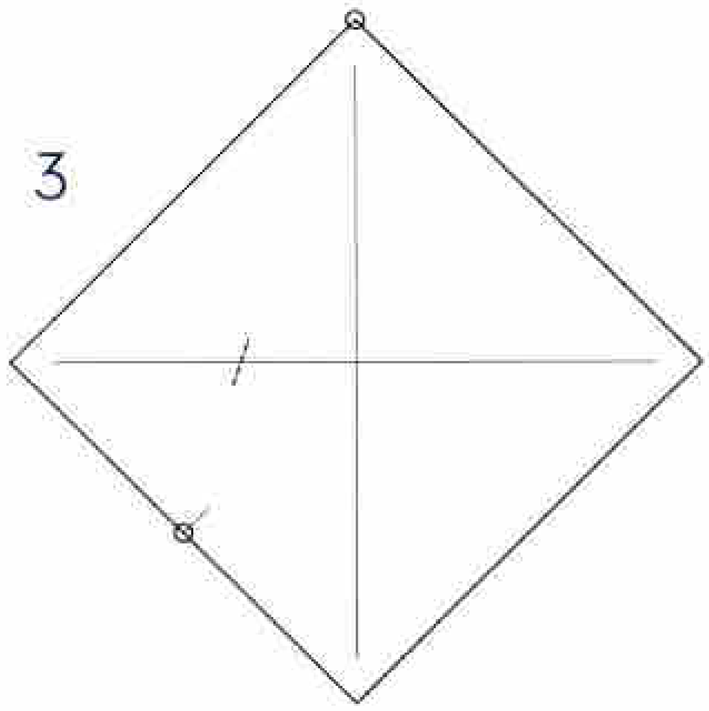


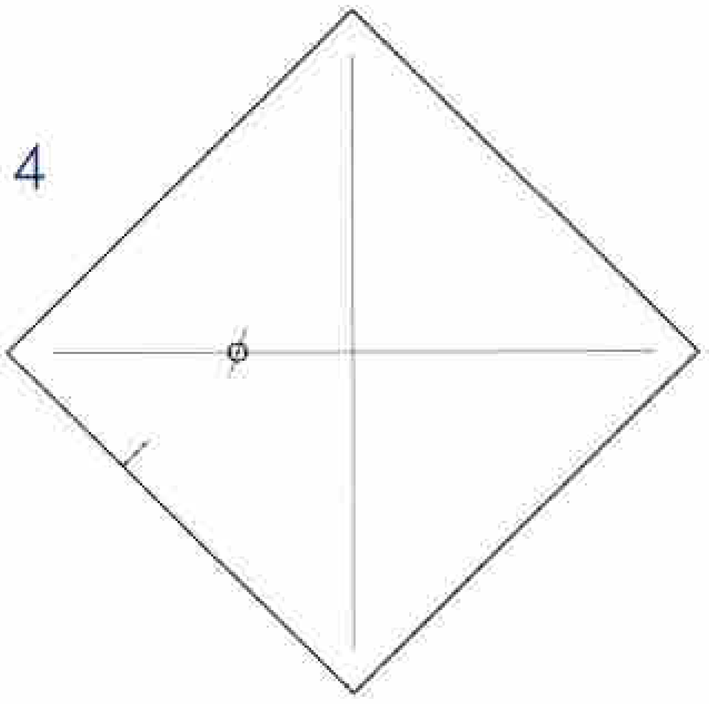
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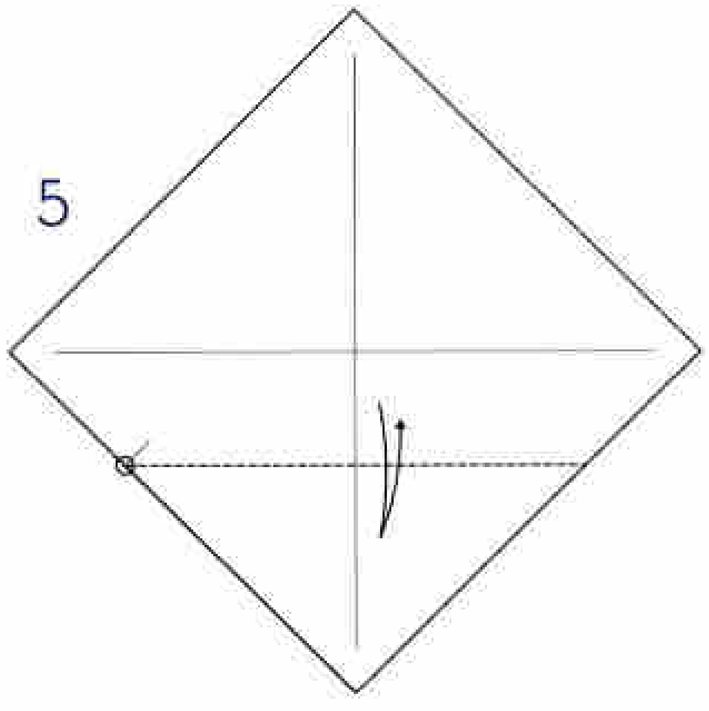
Crease at intersection. Use reference.

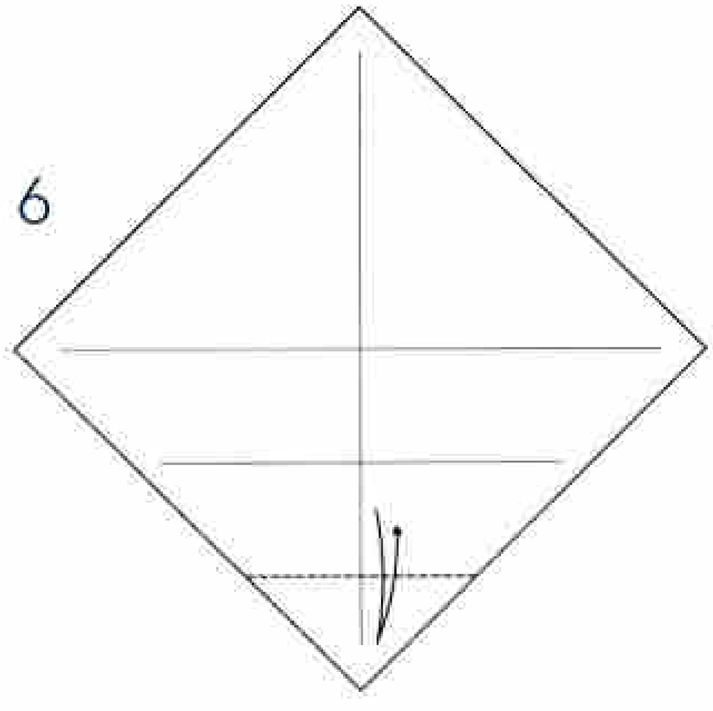




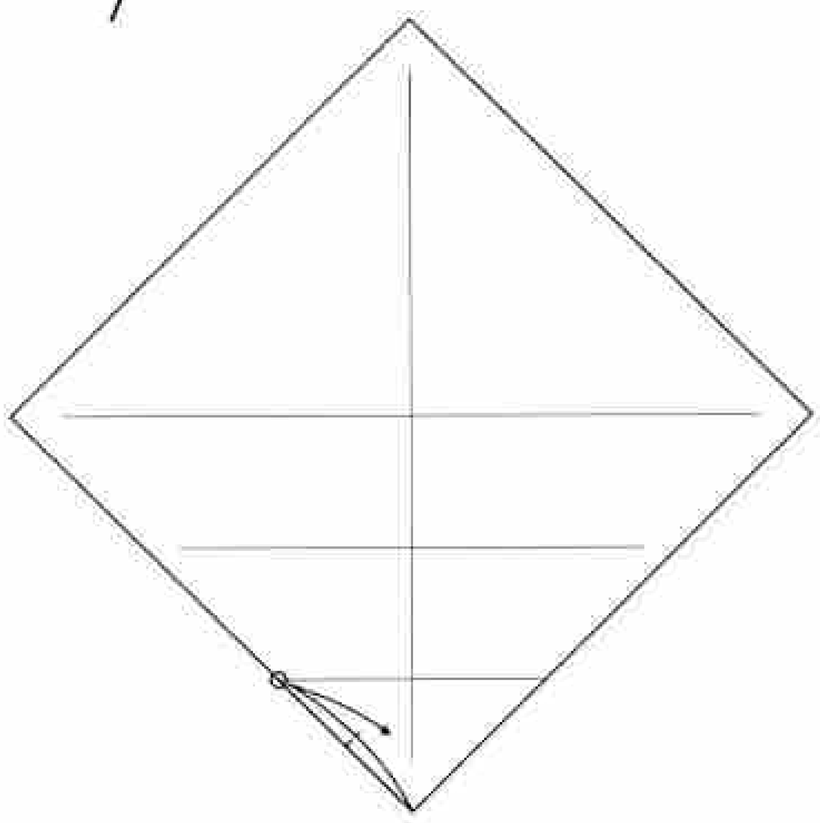




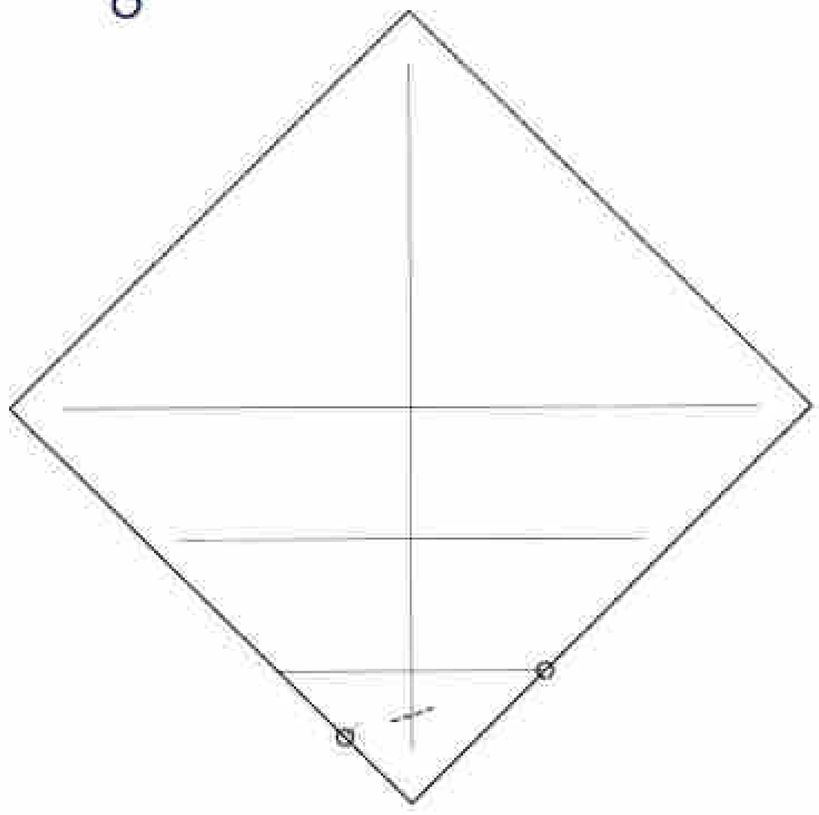




7



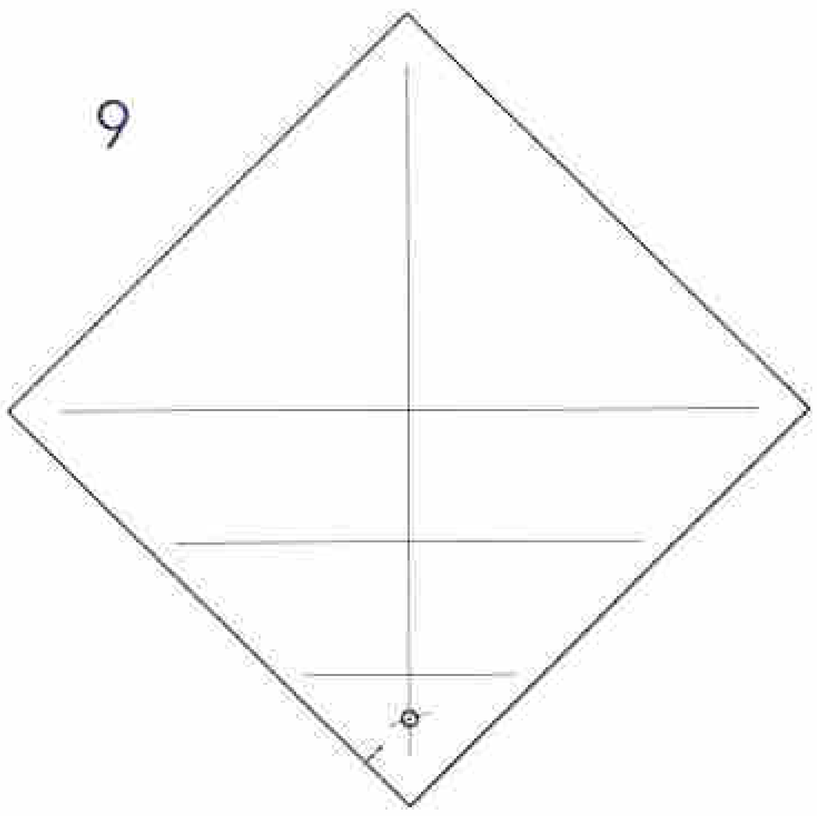
8



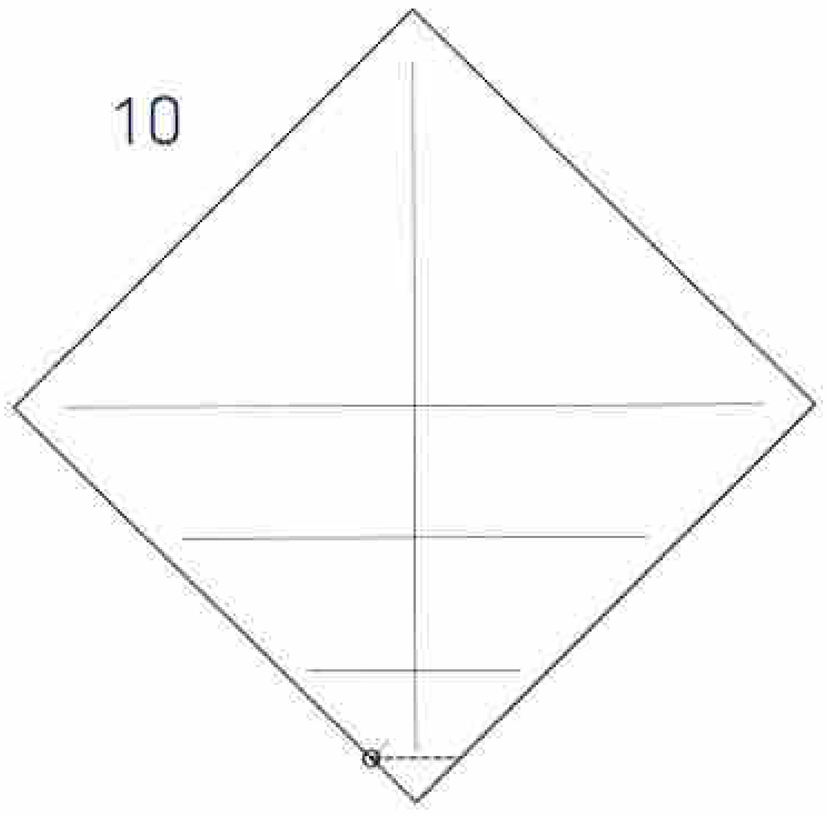
10

Bring the center crease to the reference points and back.

9



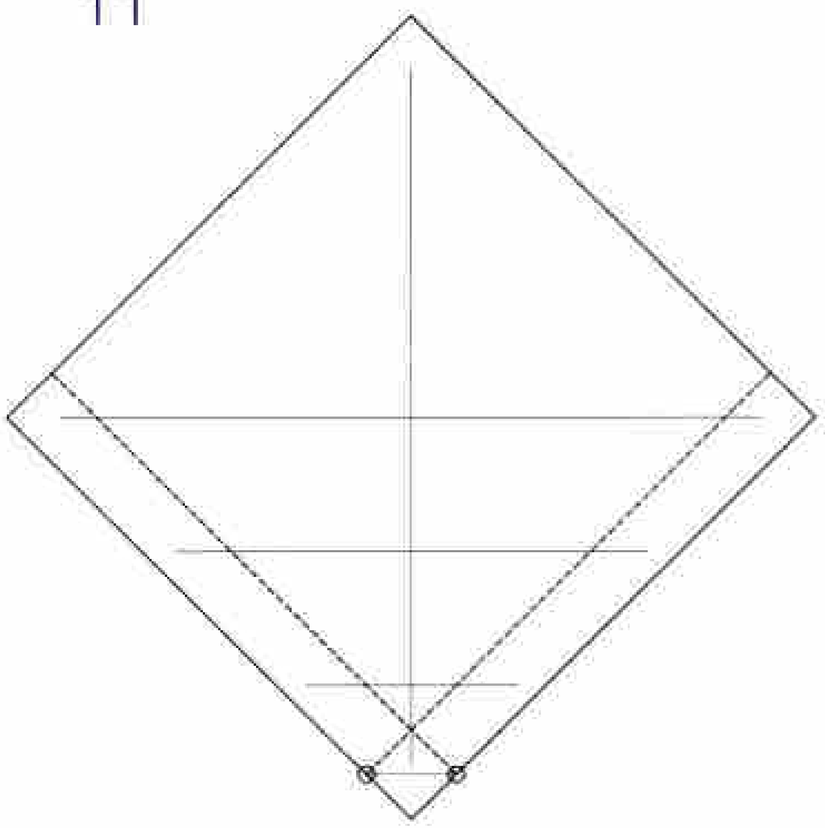
10



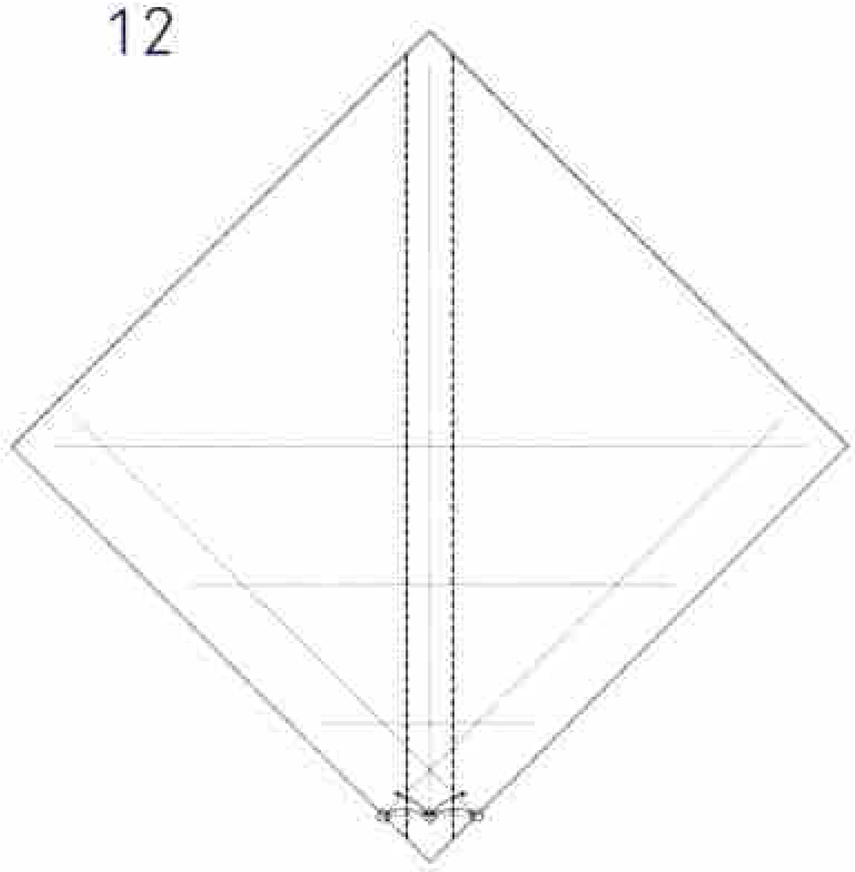
12
Bring the center crease to the reference points and back.

13
Divide columns.

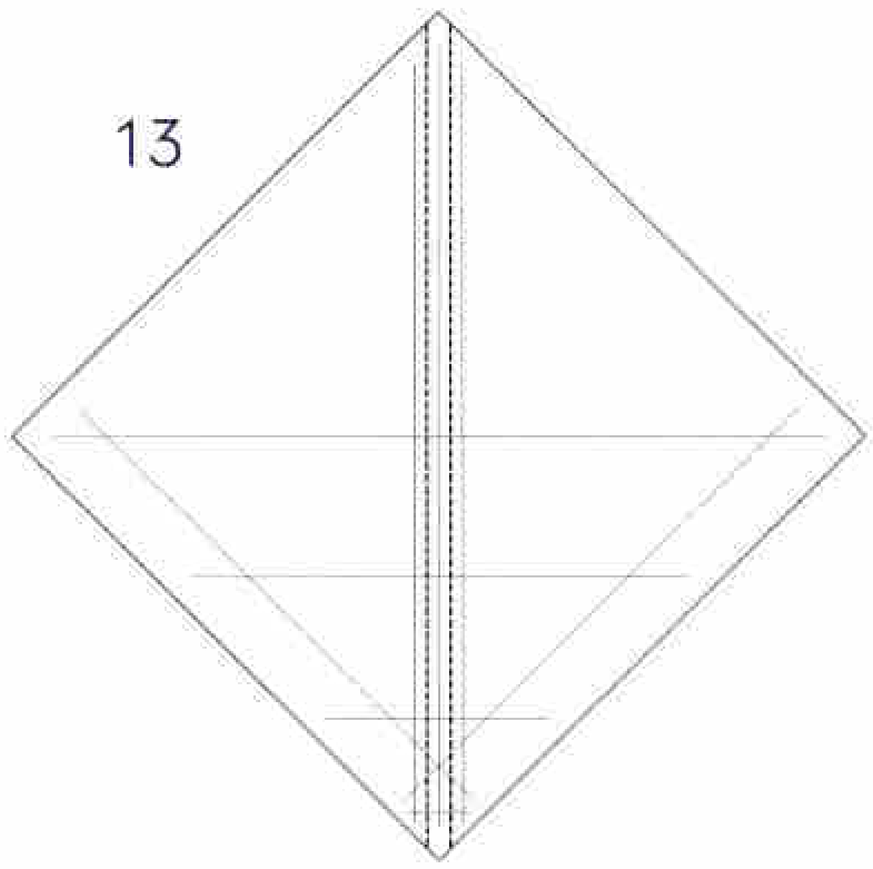
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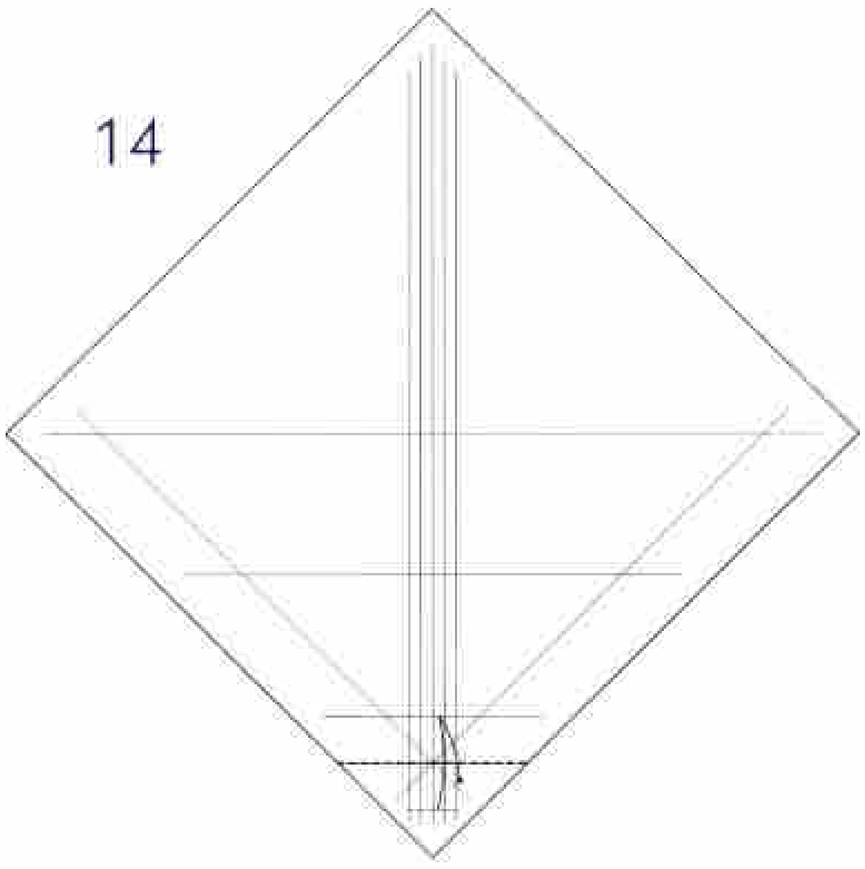
12



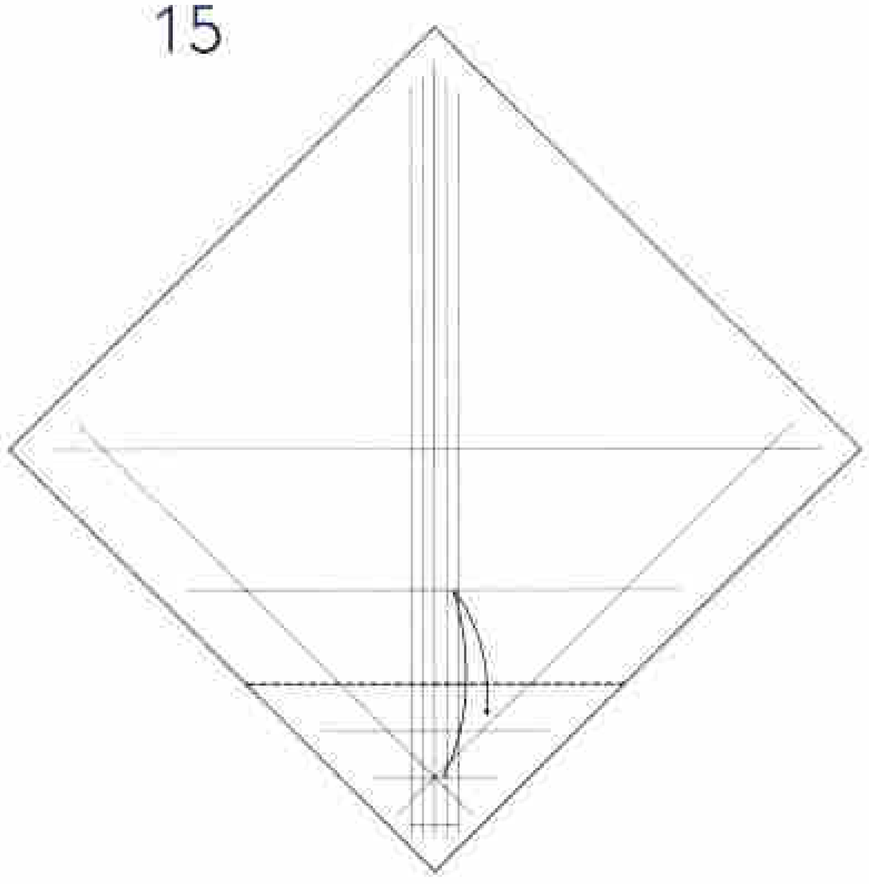
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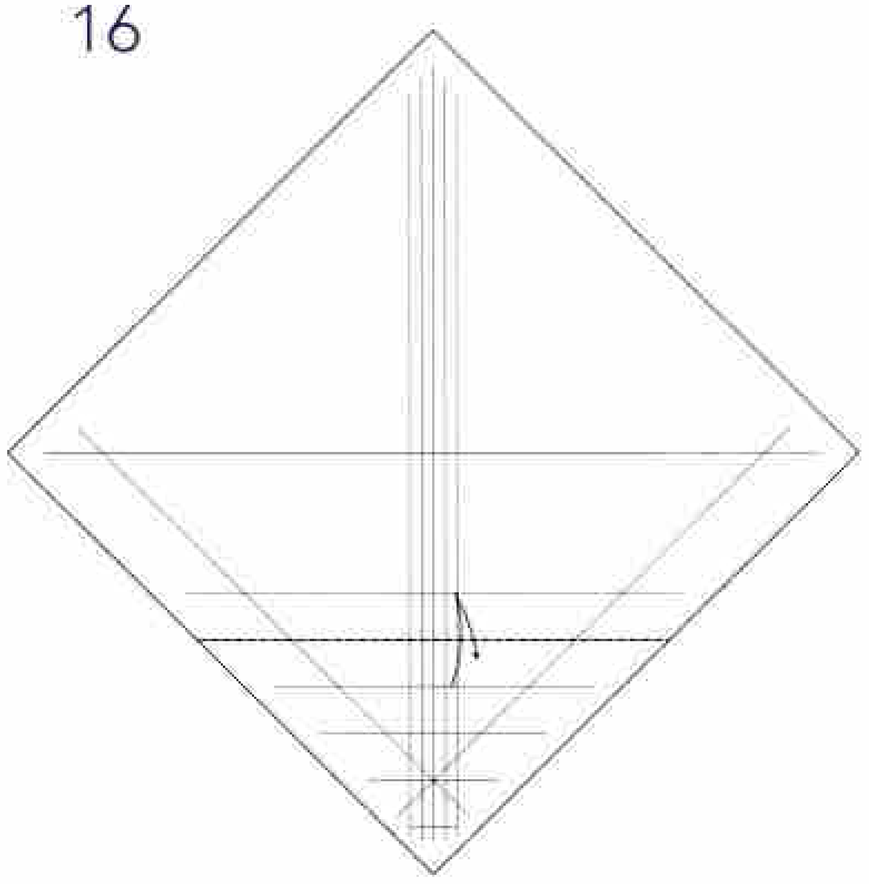
14



15

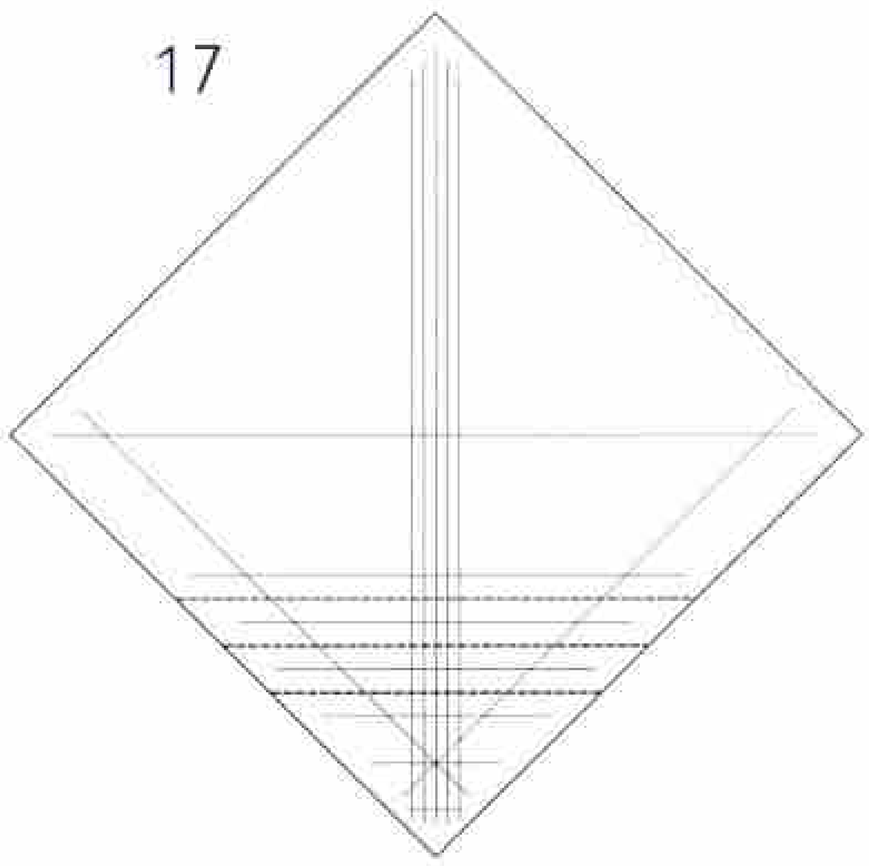


16



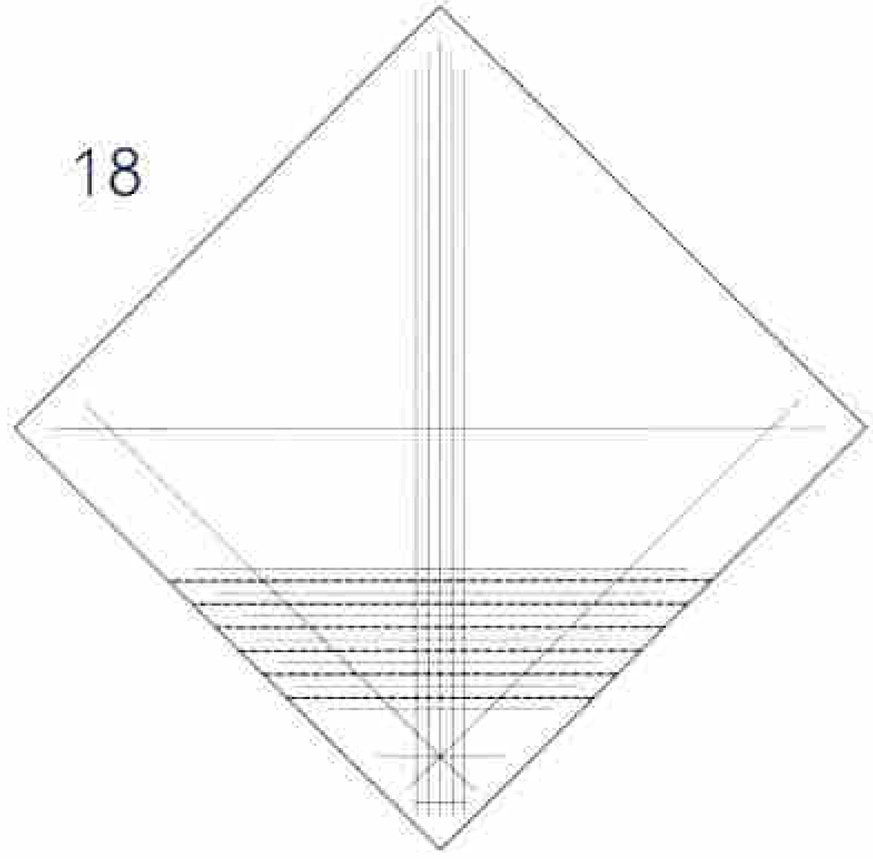
17

Divide. Three valley folds.



18

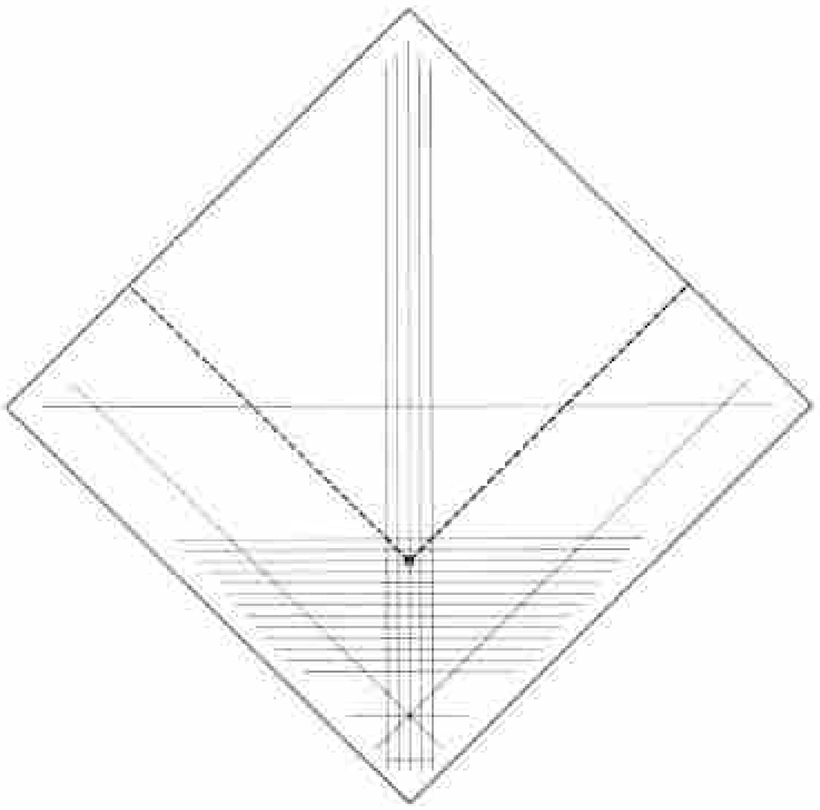
Divide again. Six valley folds.



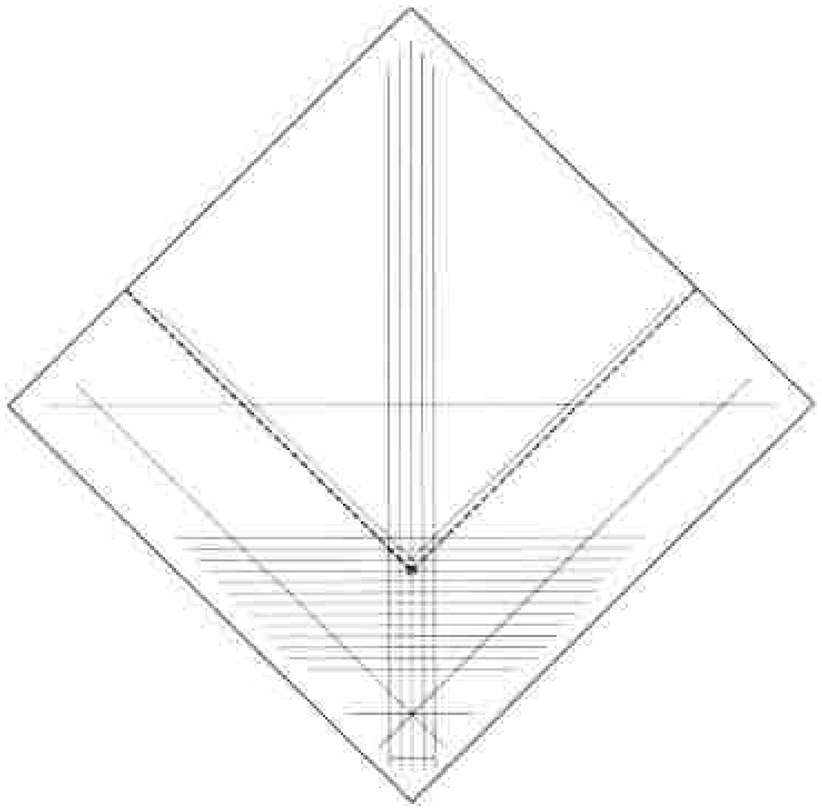
19
Reference point two lines down.

20
Reference point three lines down.

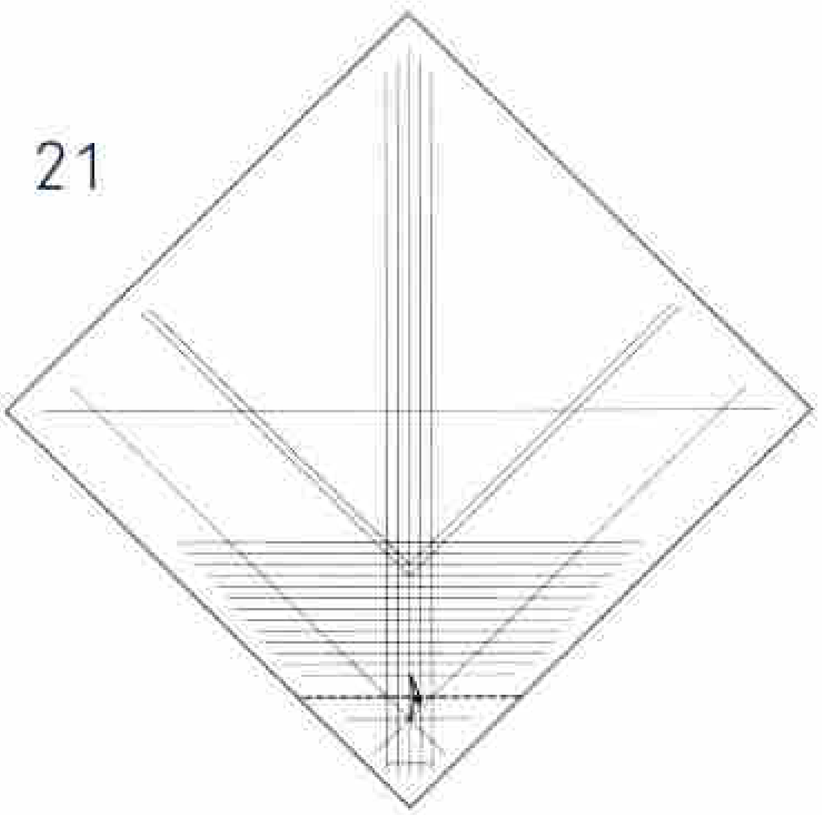
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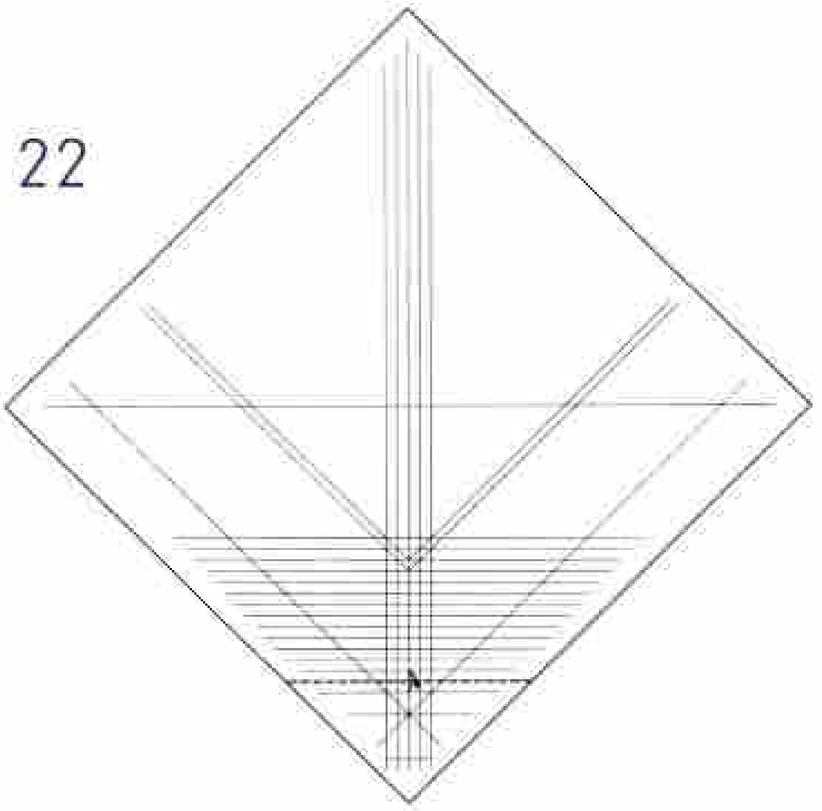
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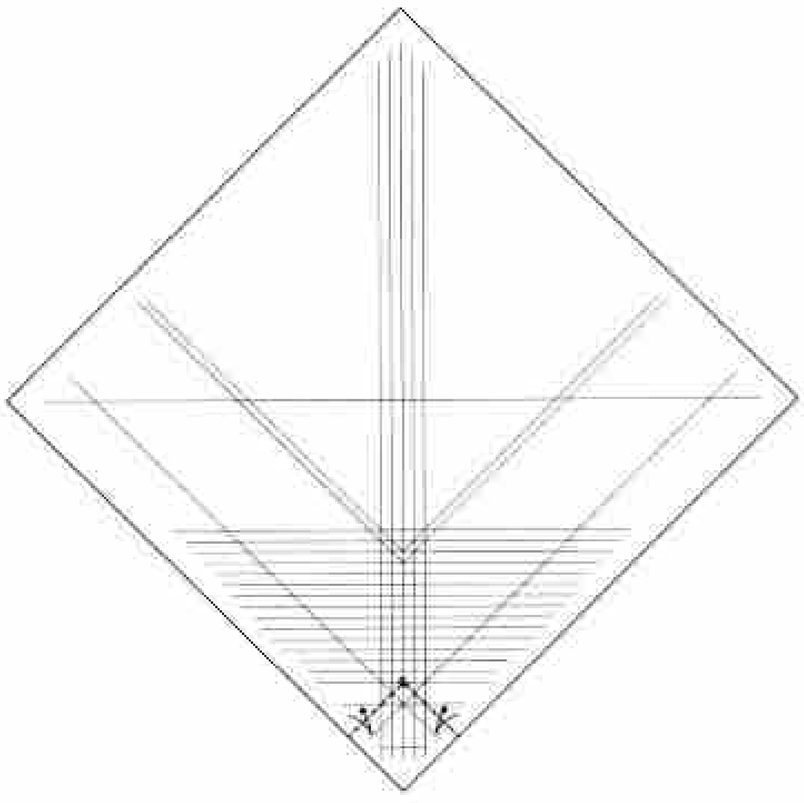
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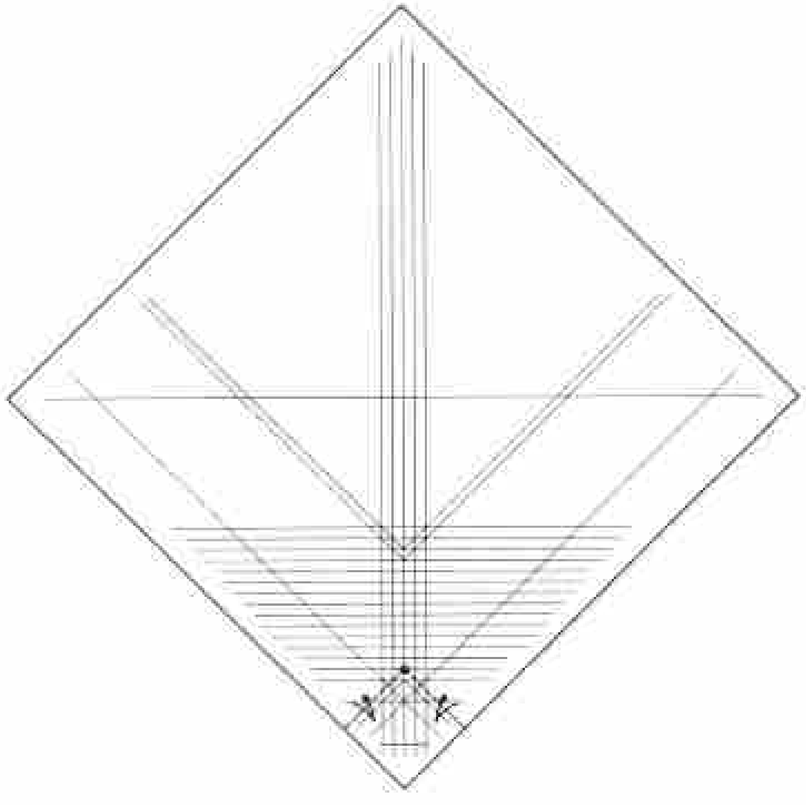
22



23



24



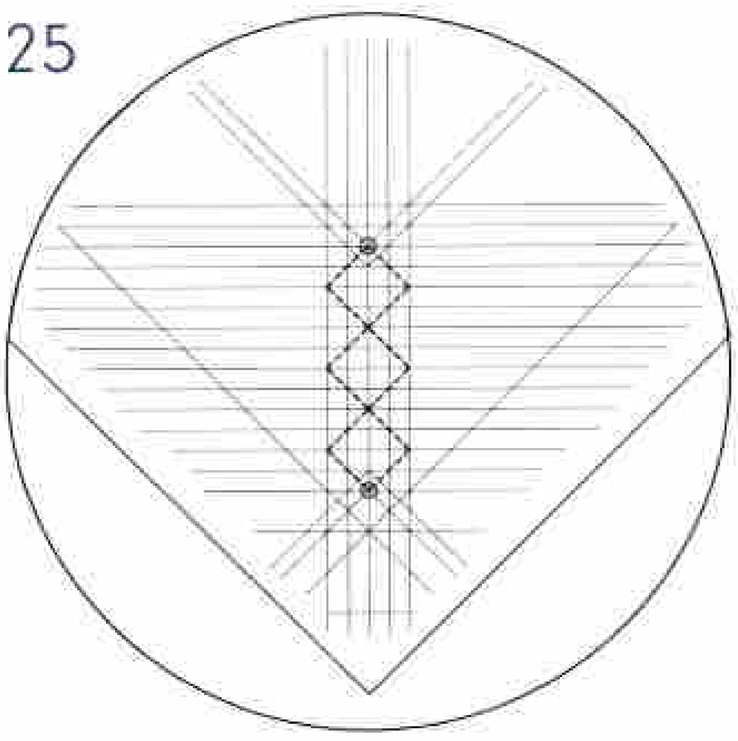
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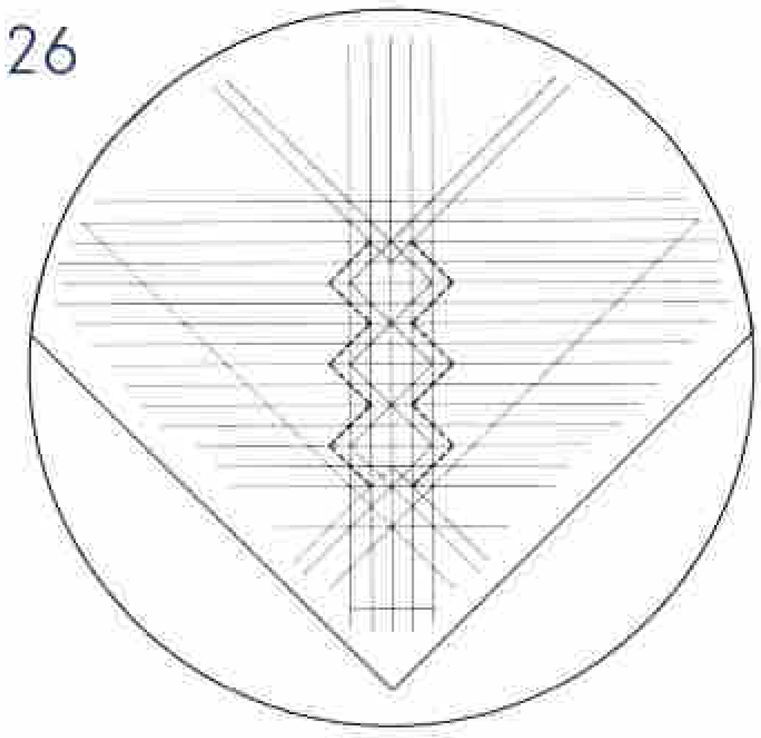
Fold and unfold.

Use references.

26

Fold and unfold.

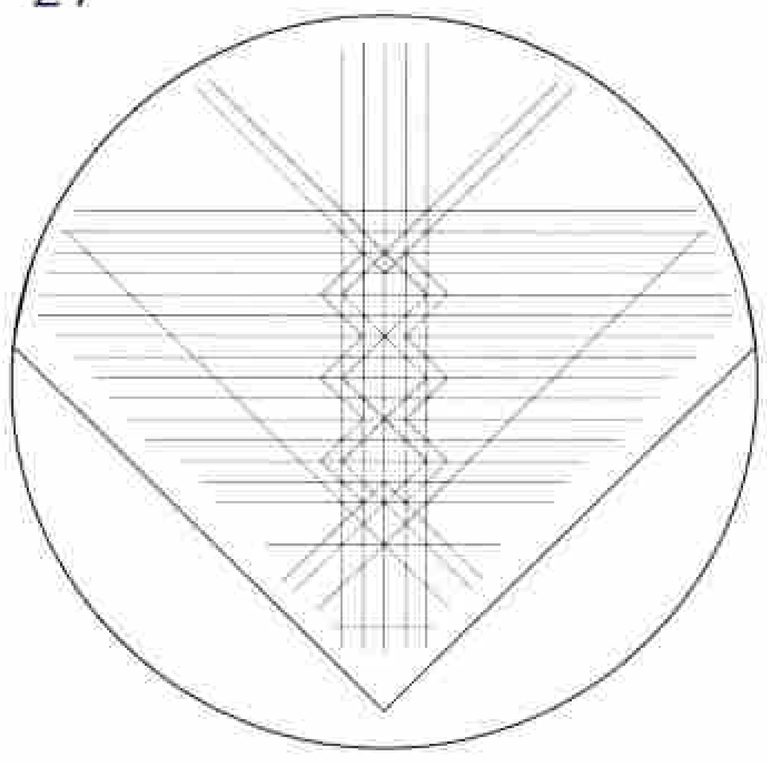




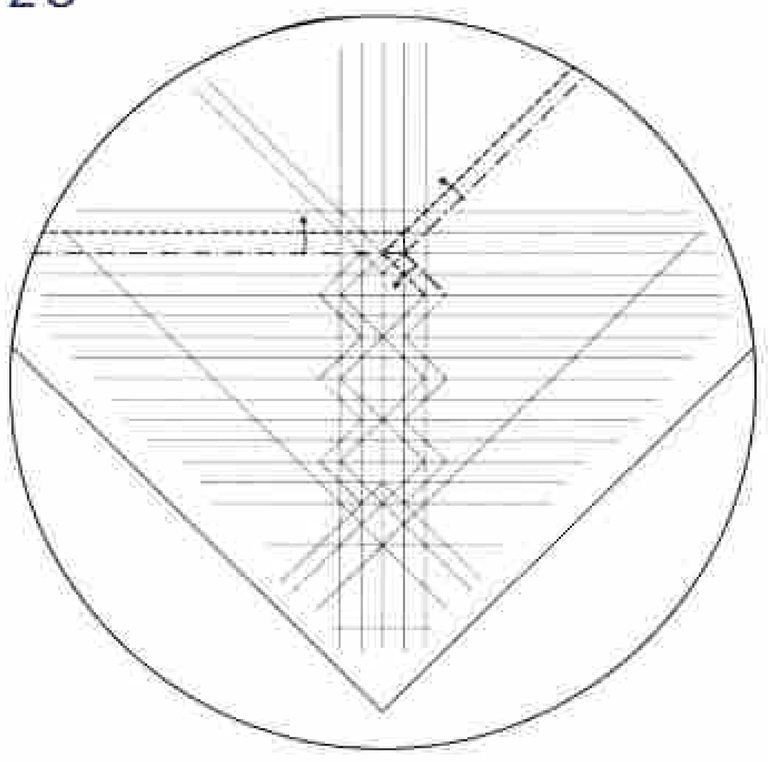
28

Collapse as shown.

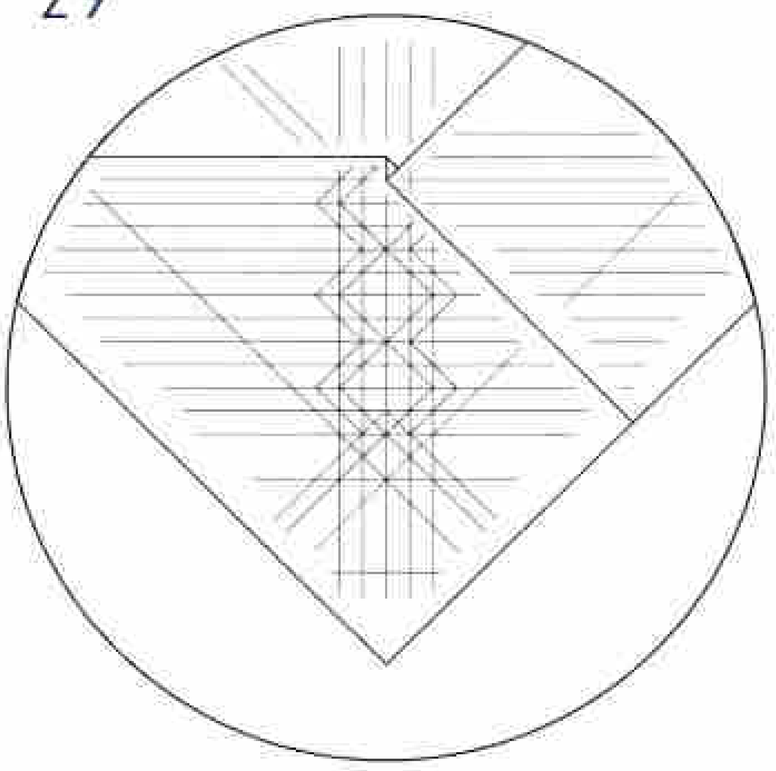
27



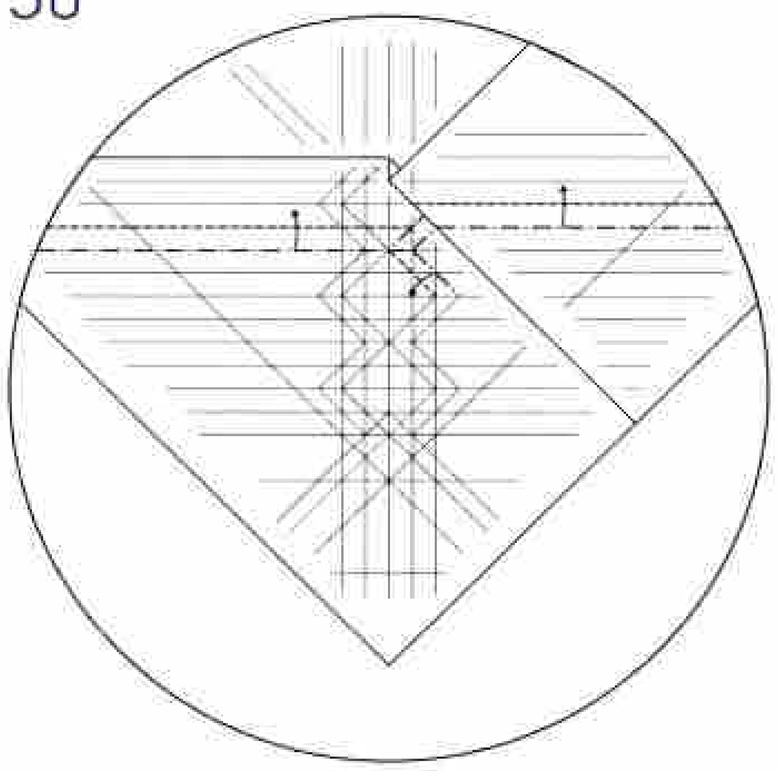
28



29

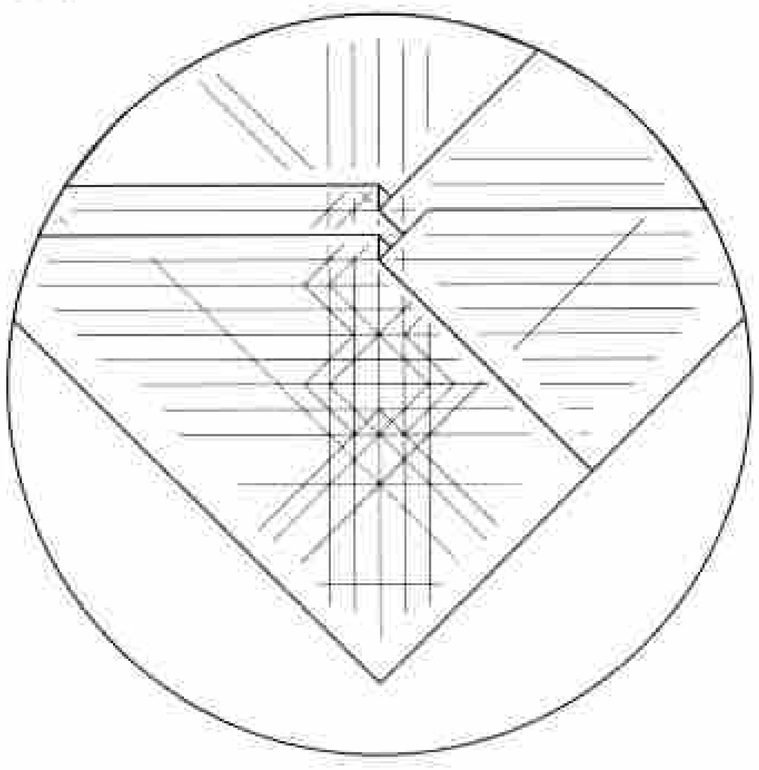


30

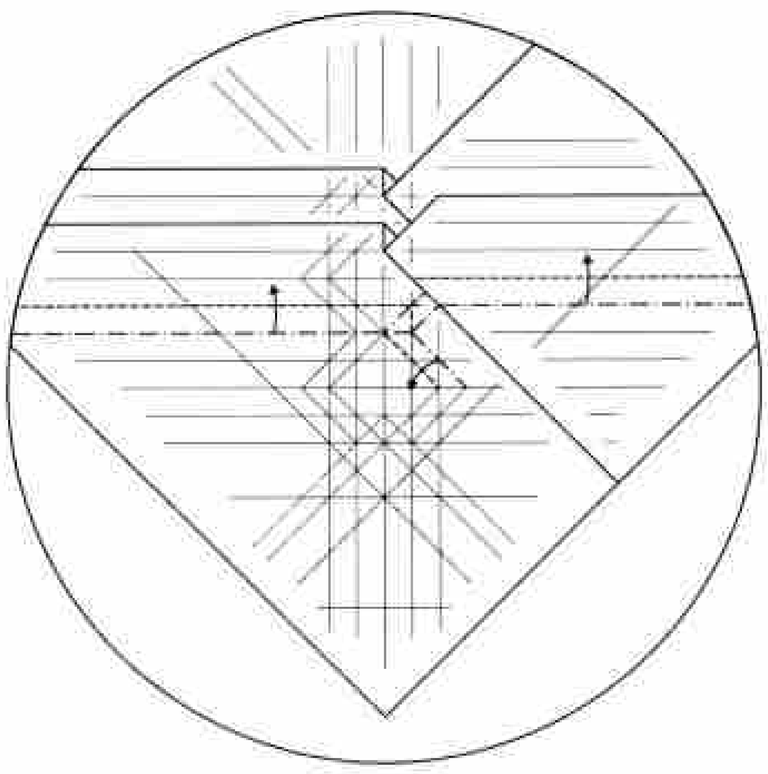


28
Collapse as shown.

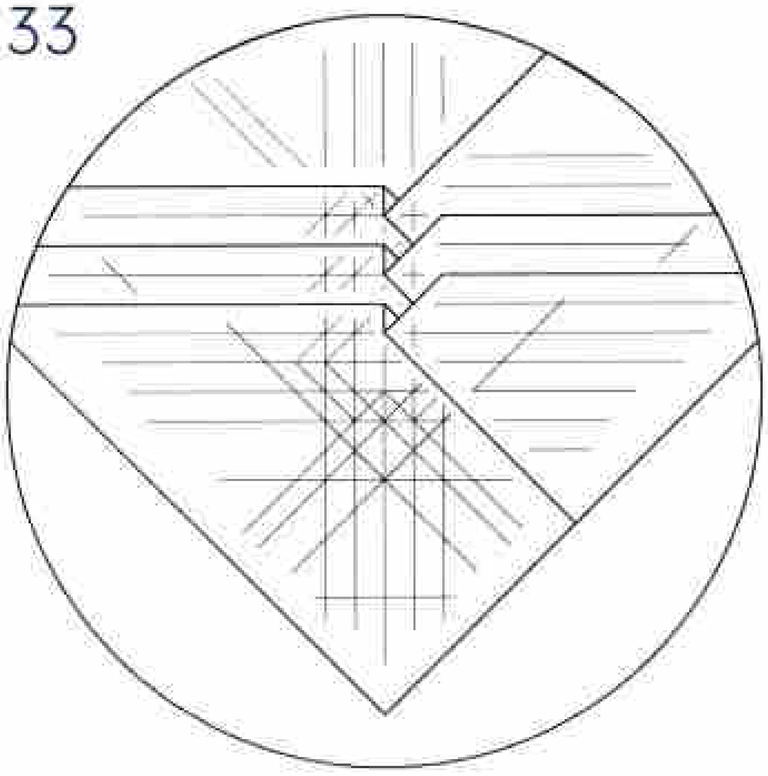
31



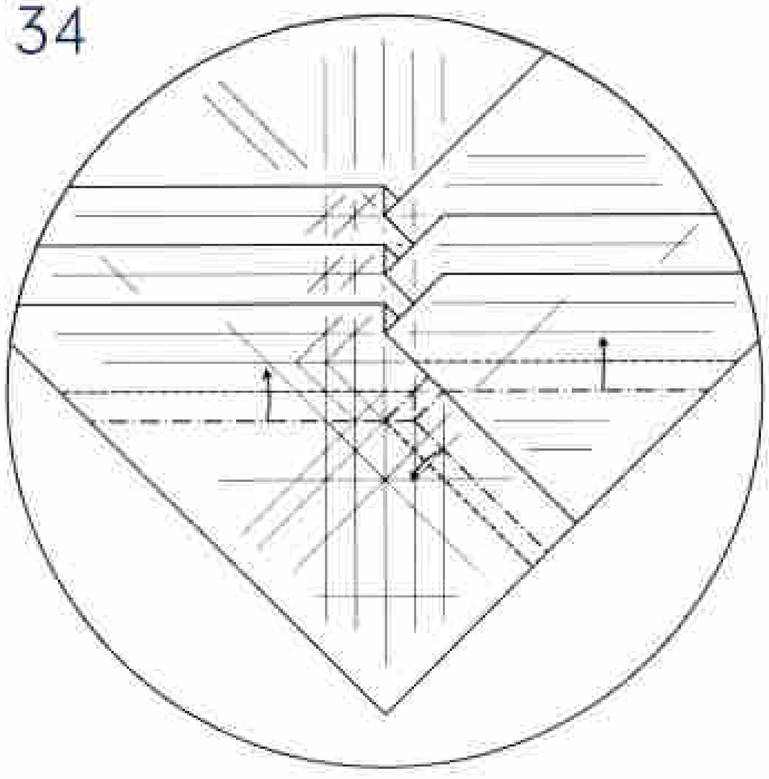
32



33



34



35

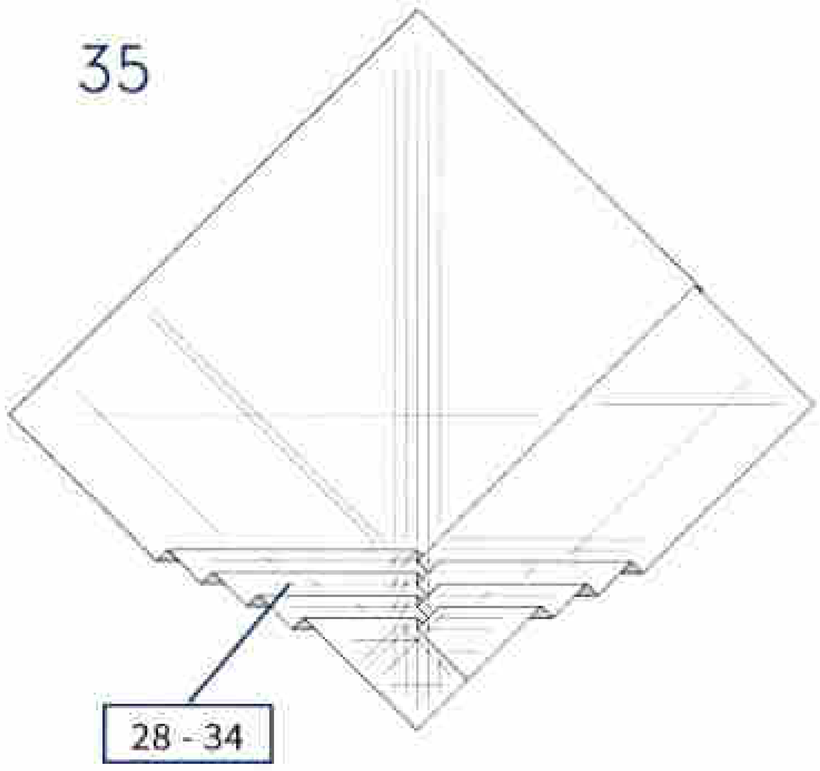
Repeat steps 28 to 34 on the left side.

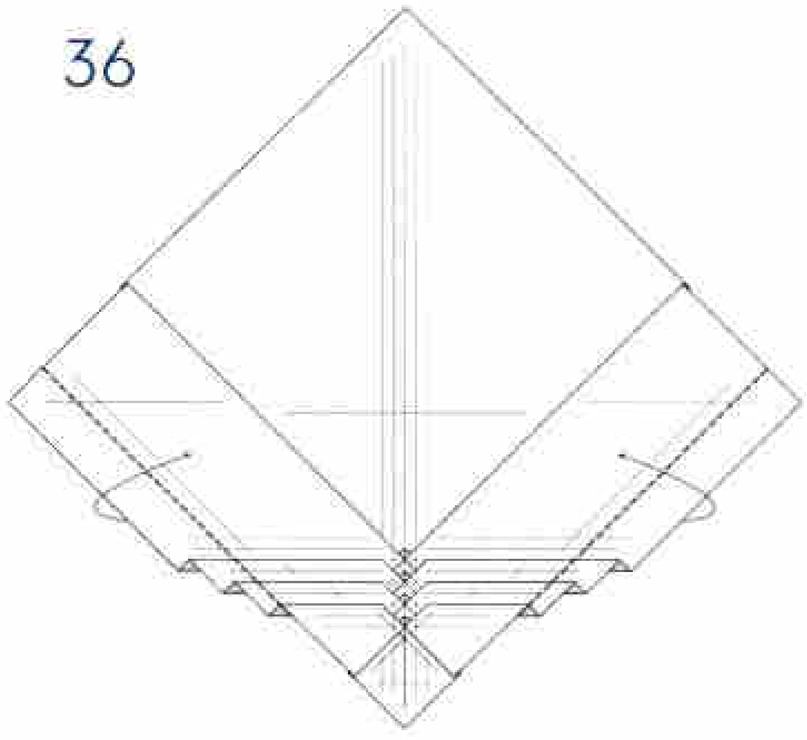
36

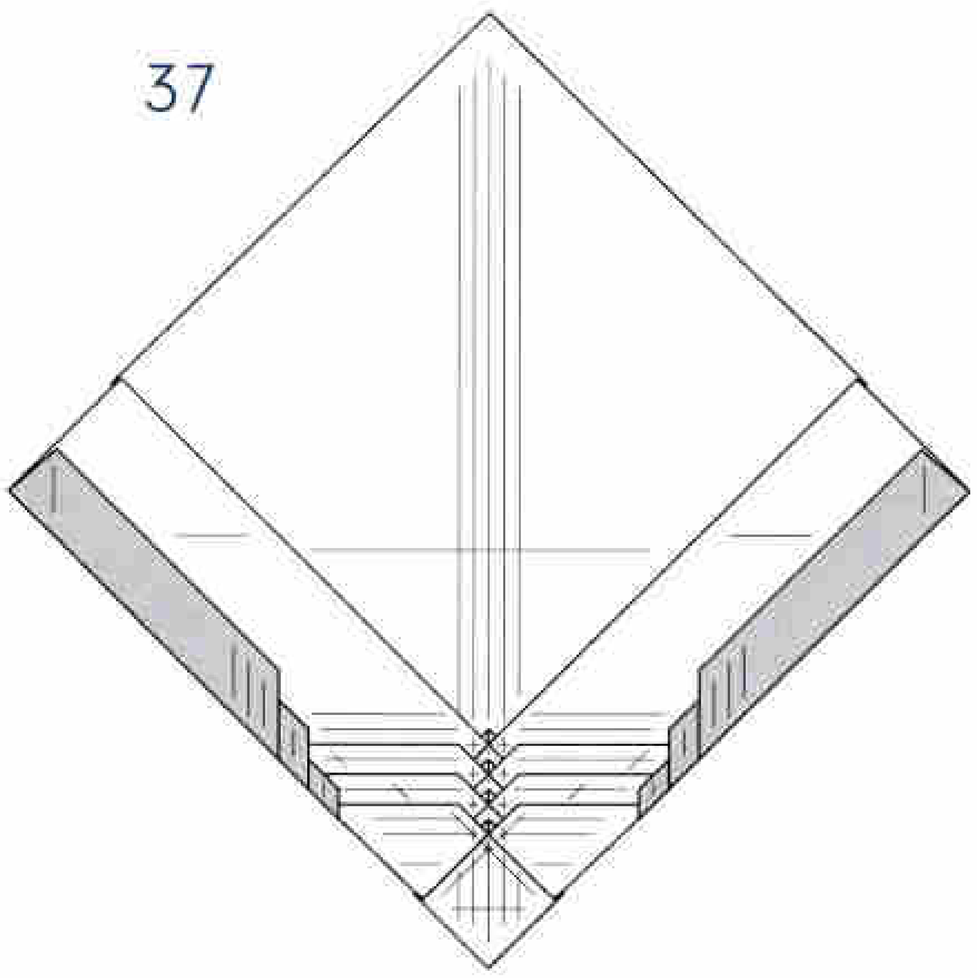
Valley folds through all layers.

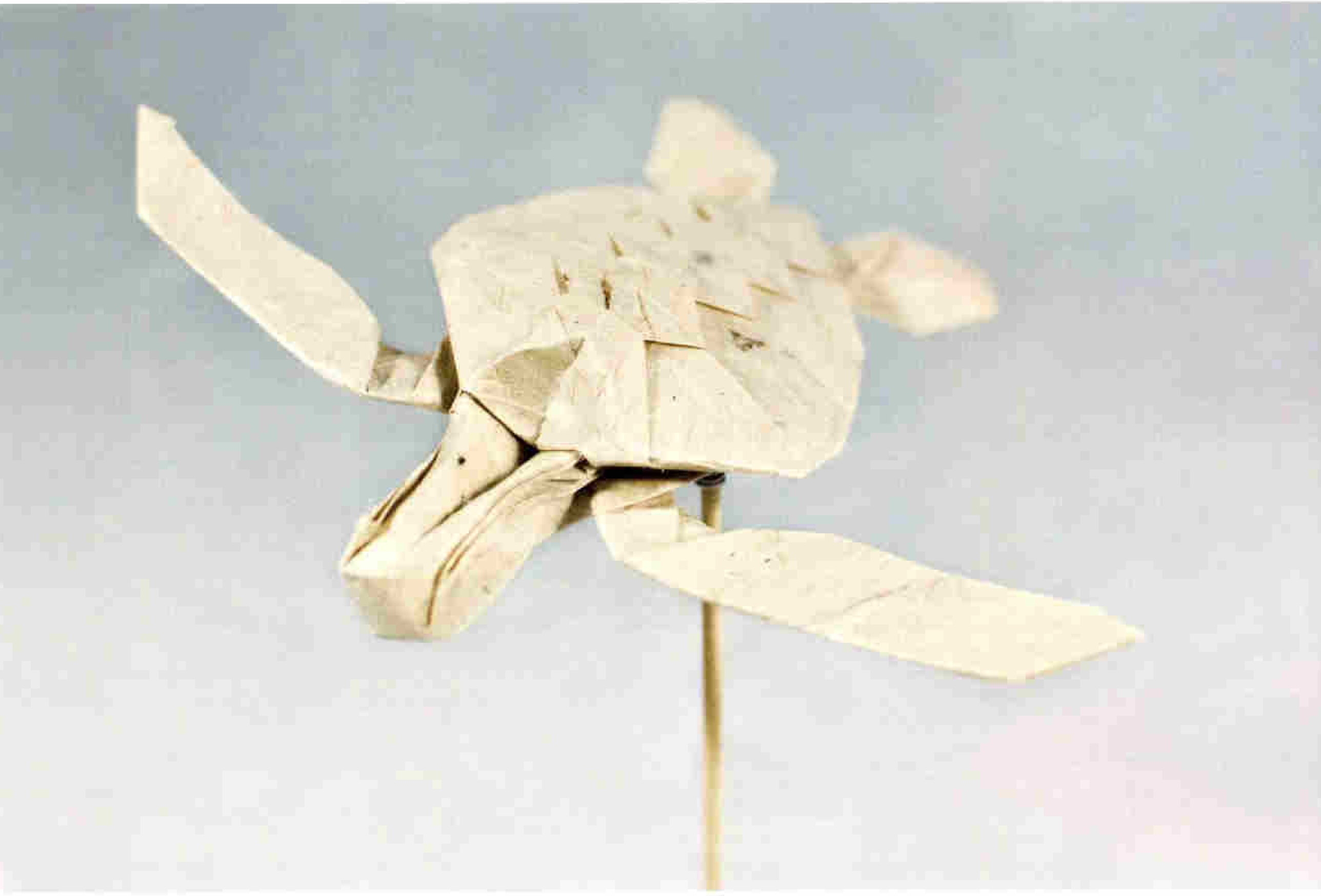
37

Sea turtle shell precrease completed. Begin on step 2 of the sea turtle.









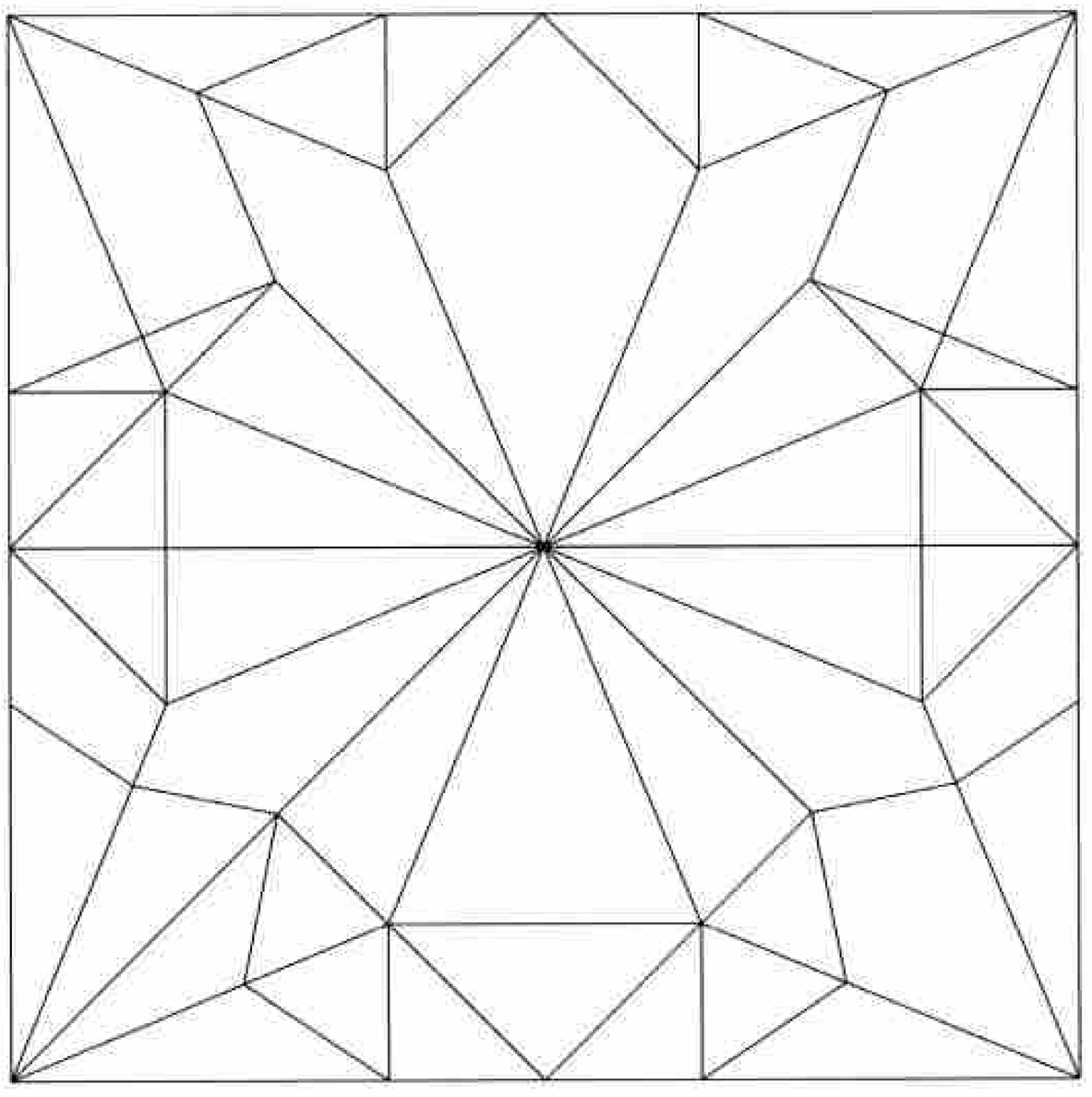
Echinoderms

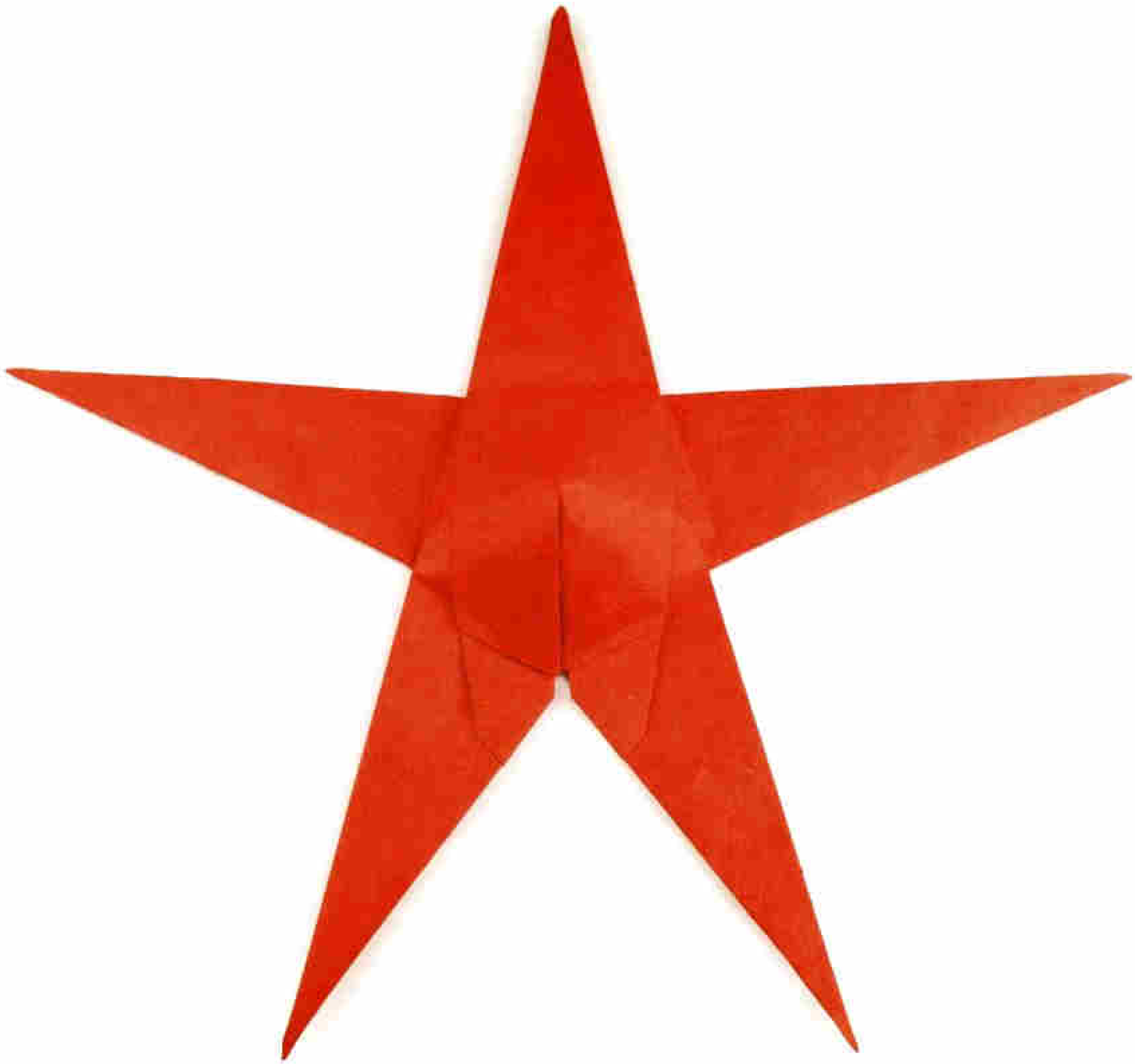
Starfish

Starfish

Starfish, or sea stars, are commonly found wedged in between rocks in tidepools and in the intertidal zone consuming mussels and other mollusks. Like other echinoderms such as sea urchins, their bodies are lined with hundreds of tiny appendages that enable them to move and hold onto things. Unfortunately for starfish, populations have diminished in recent years due to sea star wasting syndrome, an issue that has contributed to the proliferation of sea urchin barrens along California's coast.

When designing a model like this, it is always tempting to begin with a non-square paper. However, that would present no challenge. I decided to convert the corners of the square into four of the starfish's arms and the center into a fifth arm. Conveniently, the frog base distributes the paper in that manner. Starting with the frog base, I folded out the individual flaps into a five pointed star. The next task was to thin each arm with angle bisectors. To complete the model, I crimped the small central flap into a bump and locked it with a tuck fold.





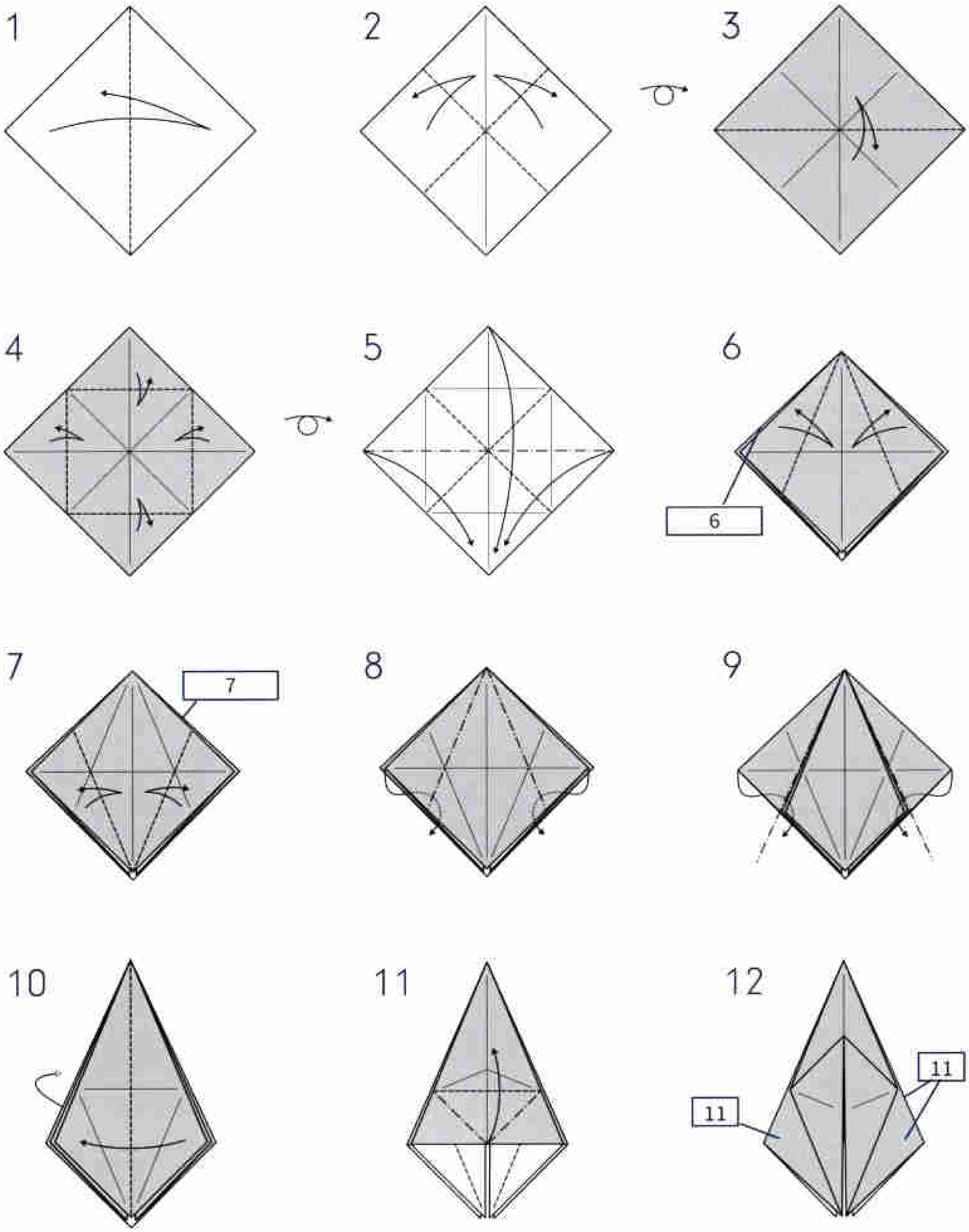
6
Fold and unfold.
Repeat behind.

7
Fold and unfold.
Repeat behind.

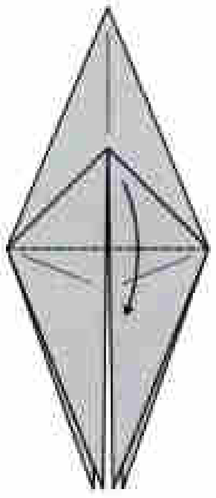
8
Inside reverse
folds.

9
Inside reverse
folds.

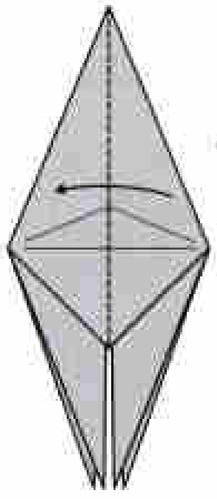
12
Repeat step 11
on each side.



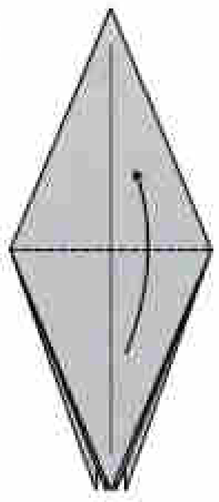
13



14



15



16

Swivel flap down.

17

Repeat steps 14 to 16 on the left side.

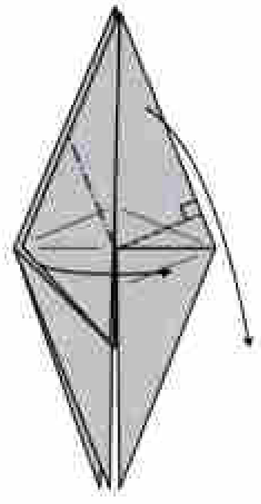
20

Swivel flap up.

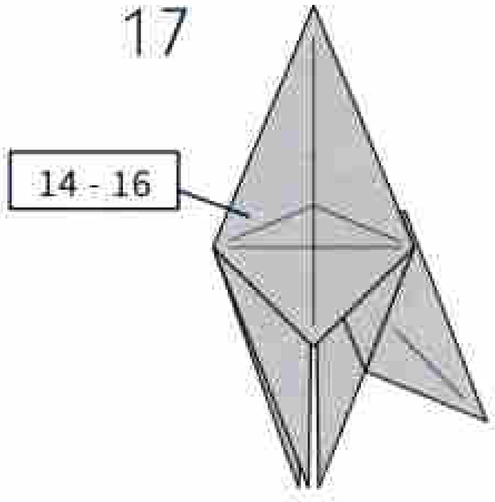
21

Repeat steps 19 and 20 on the left side.

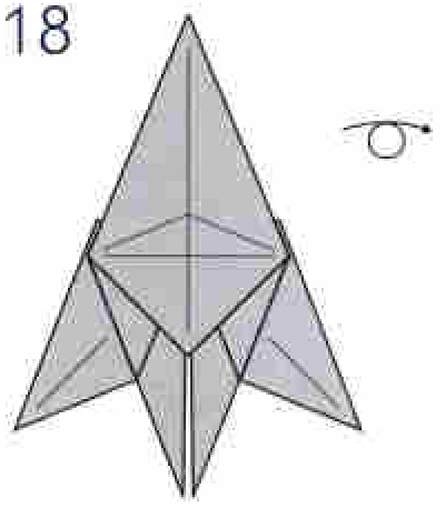
16



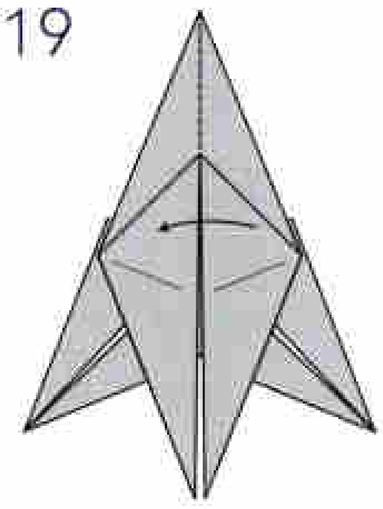
17



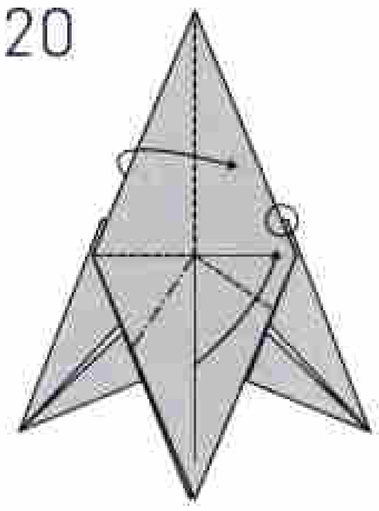
18



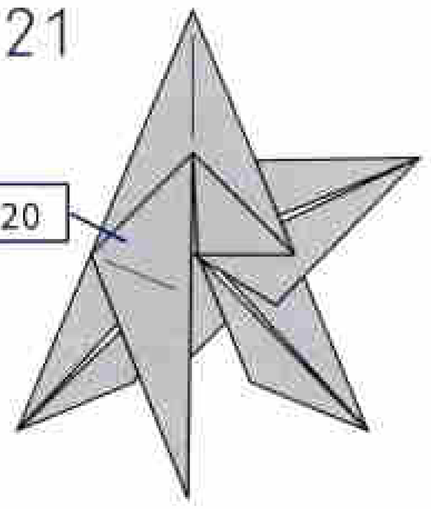
19



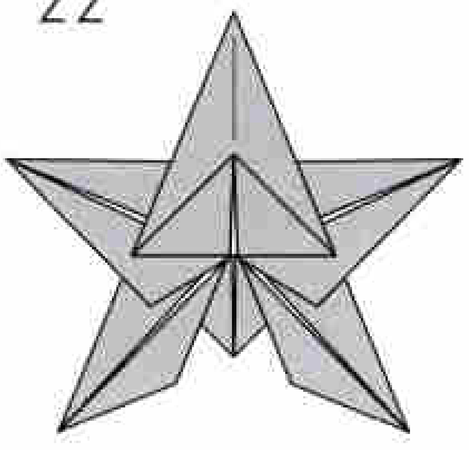
20



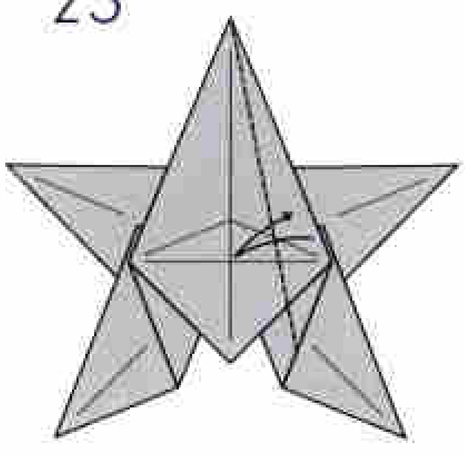
21



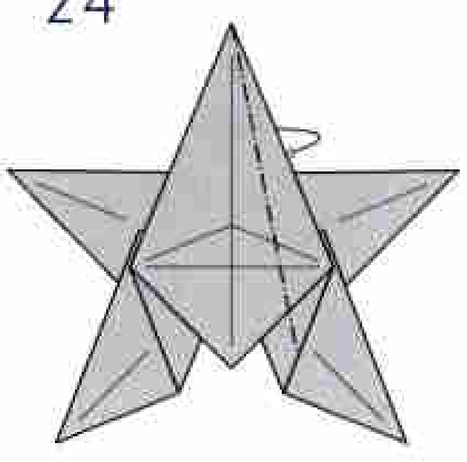
22



23



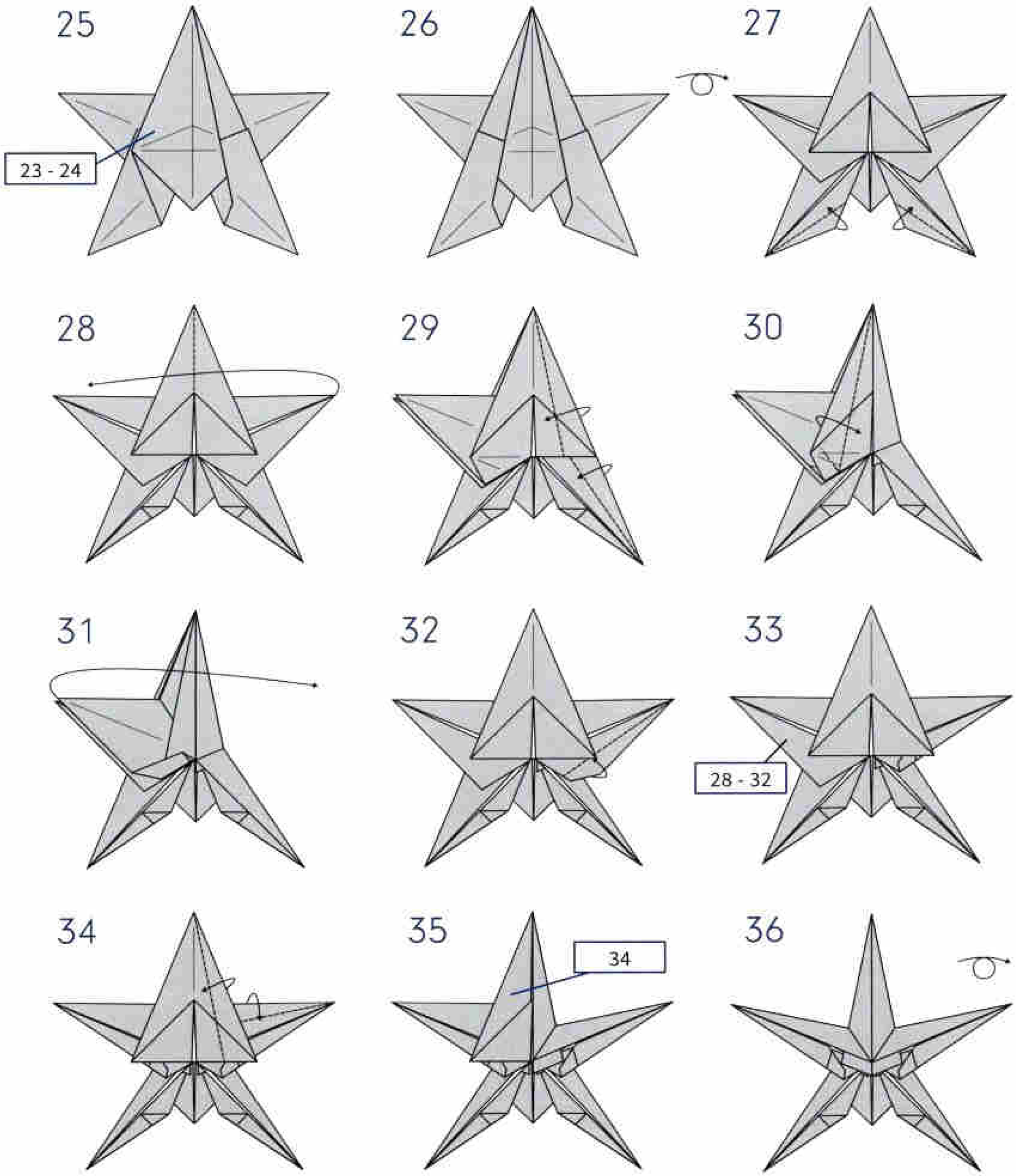
24



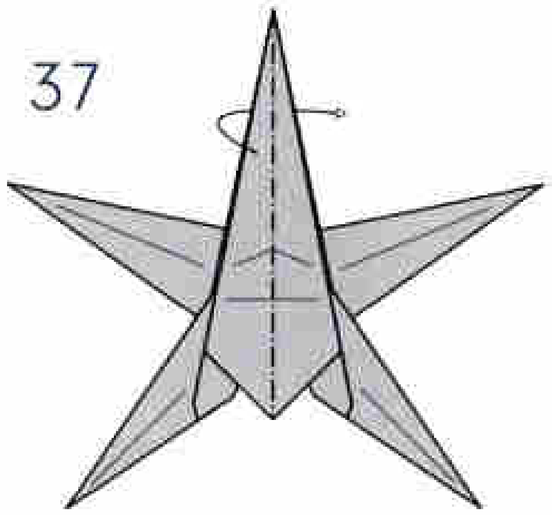
25
Repeat steps 23 and 24 on the left side.

33
Repeat steps 28 to 32 on the left side.

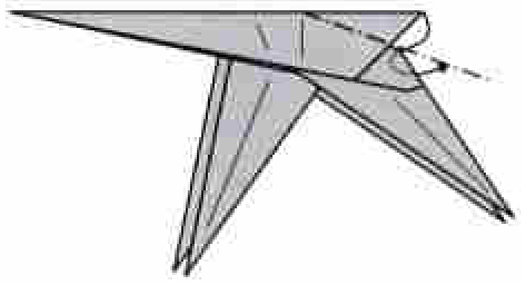
35
Repeat step 34 on the left side.



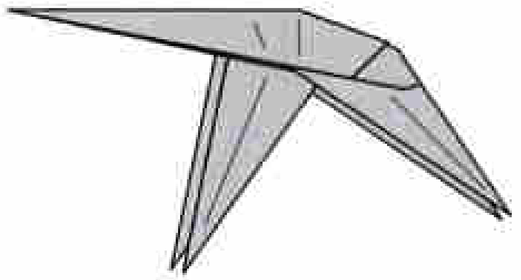
37



38



39



38
Inside reverse fold.

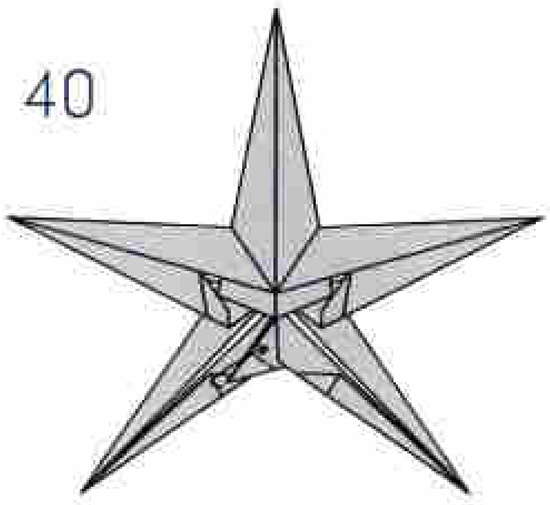
40
Angle bisector.

41
Tuck under right side to lock.

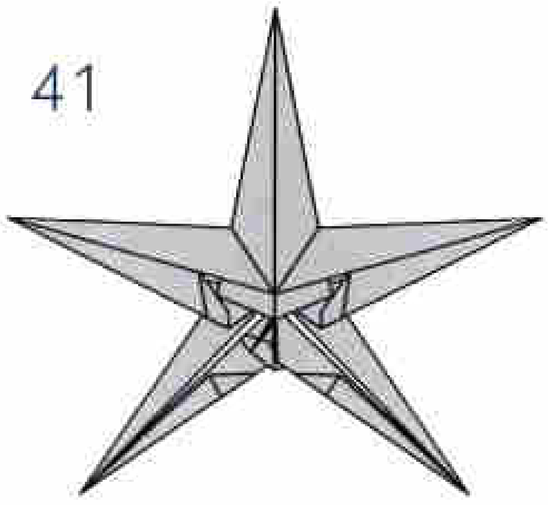
43
Shape.

44
Starfish completed.

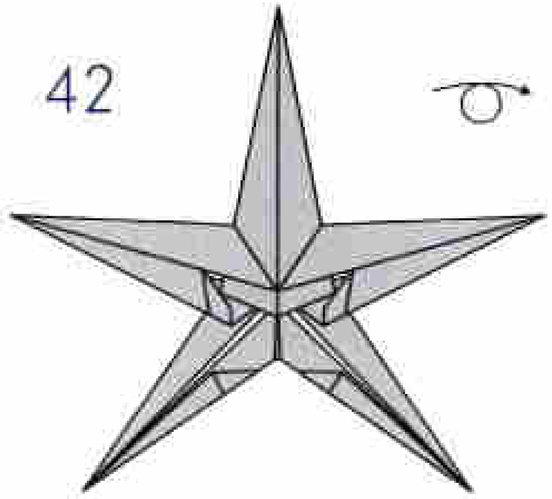
40



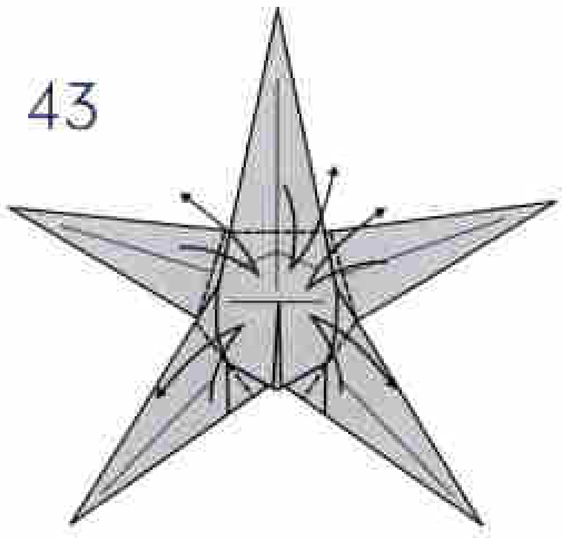
41



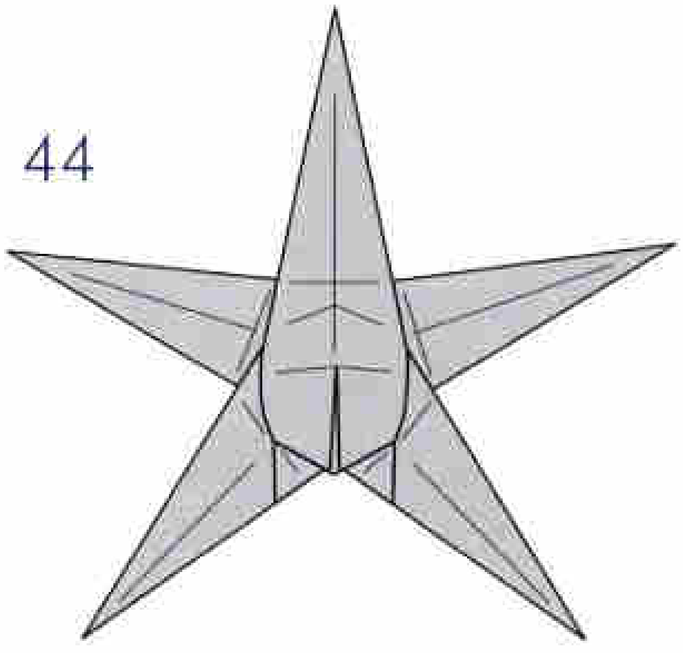
42



43



44



Sharks & Rays

Stingray

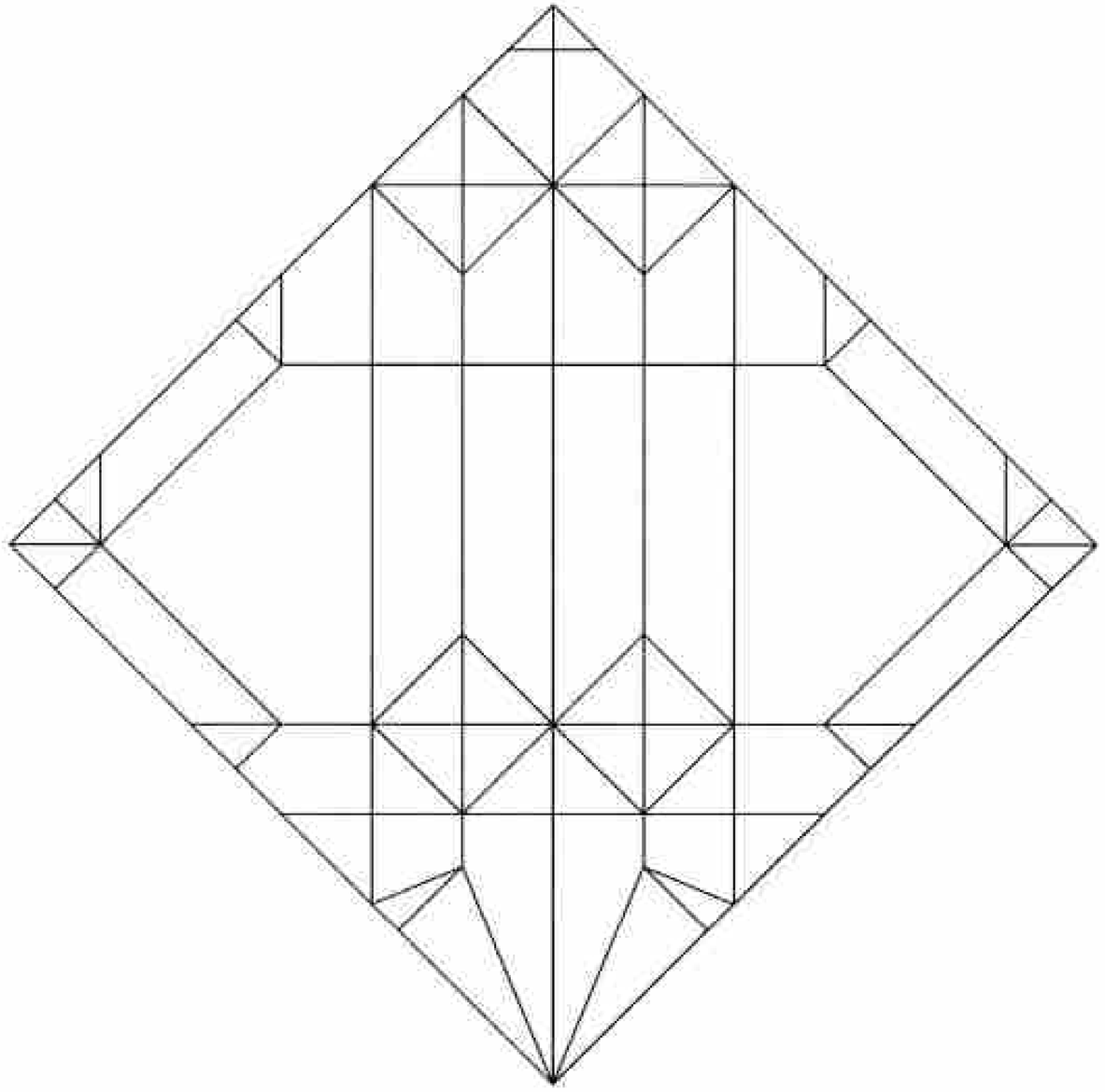
Great White Shark

Bull Shark

Stingray

Along the shores of Southern California, stingrays are very common in shallow water where they rest on the sandy floor waiting for sand crabs to eat, or an unsuspecting foot to sting. One way to avoid getting stung while returning from a dive is to float in as close as possible and perform the stingray shuffle, which is basically shuffling your feet along the seafloor.

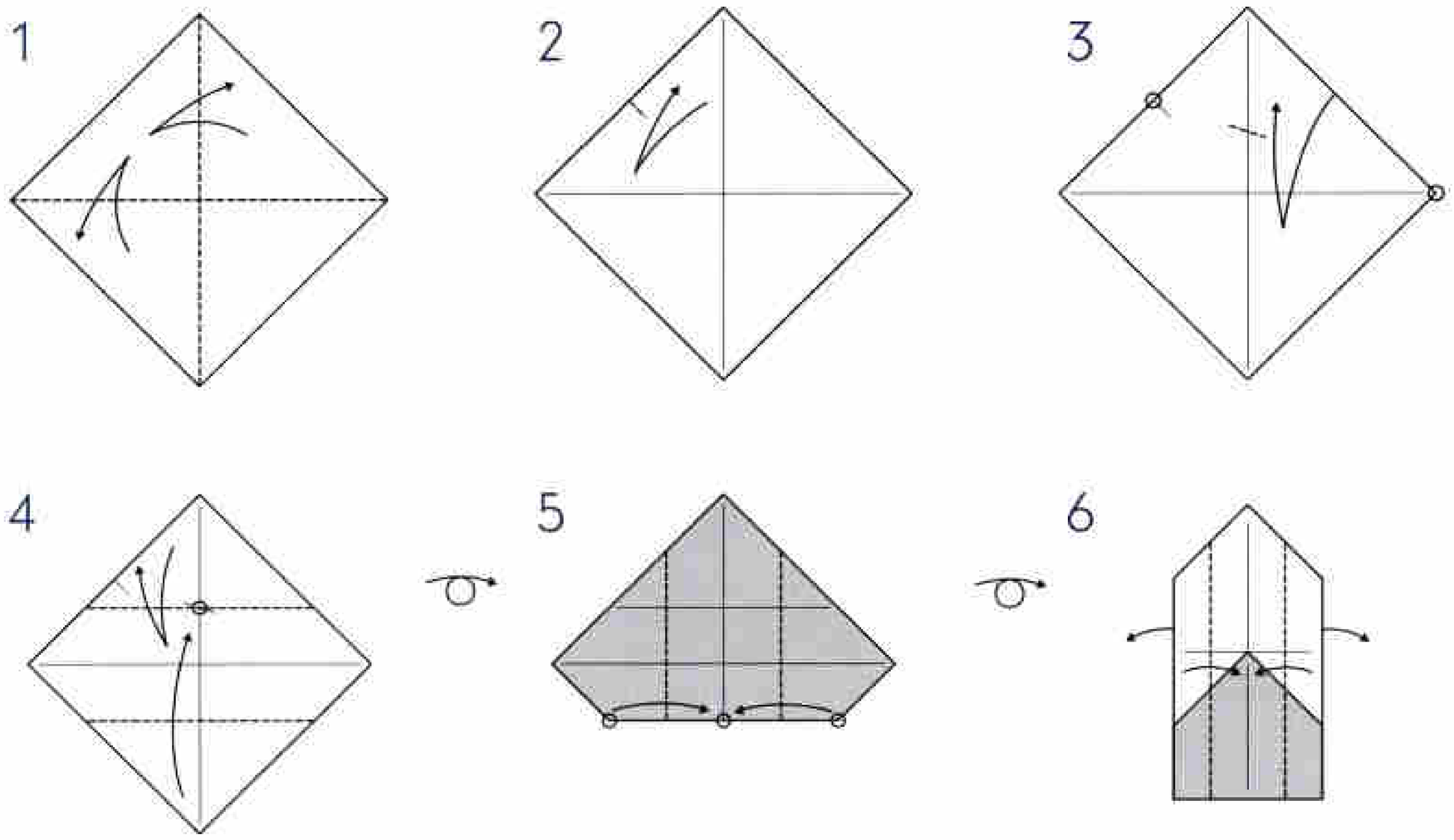
This model was designed around the same time as the flounder. They both share similar structures in the design: symmetric pleats down the center that produce paper for the head and tail folds. The pleats also serve as a top layer that gives the upper body more distinction.

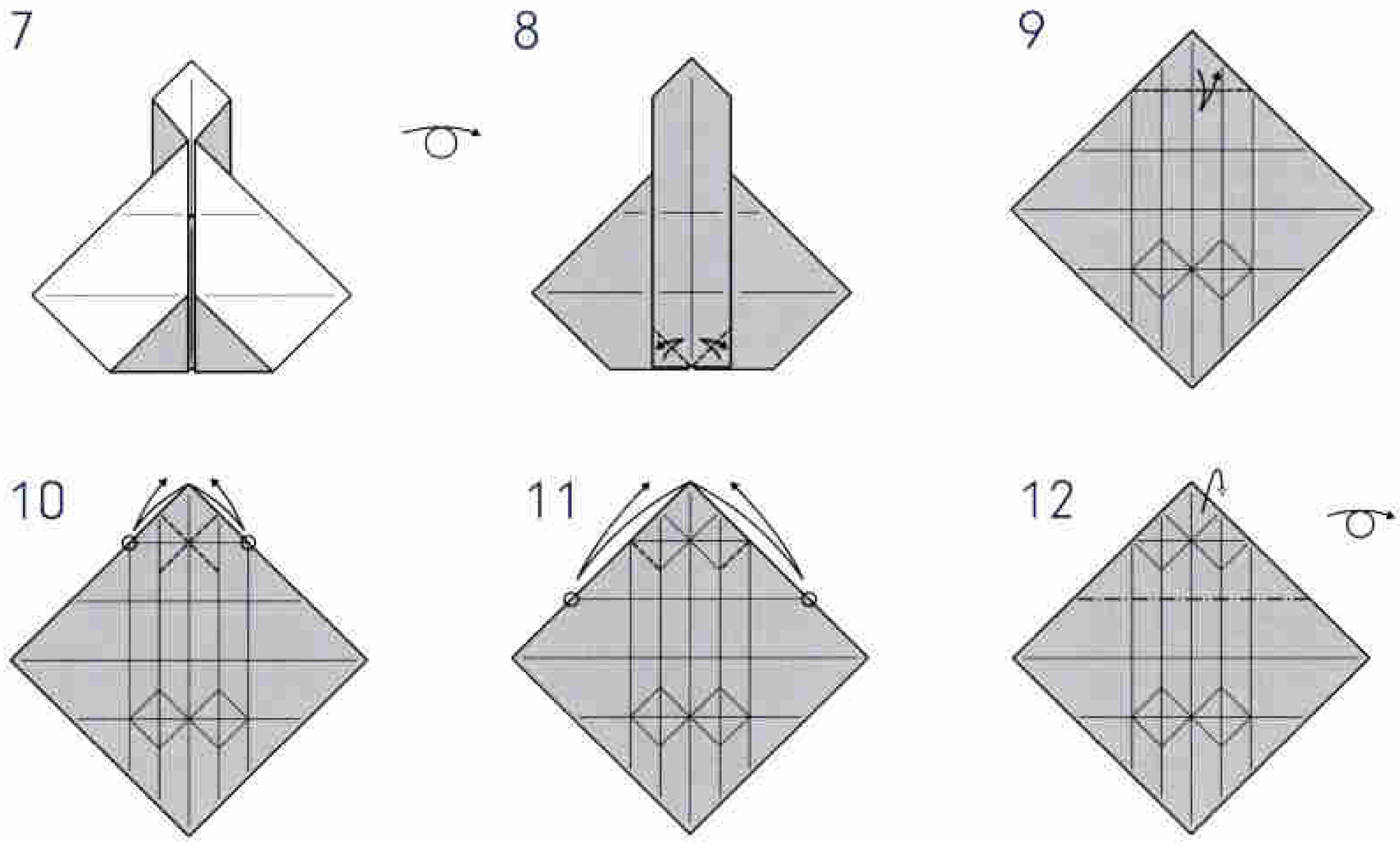




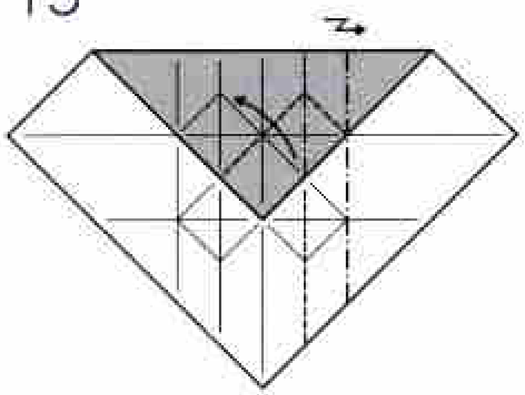
4
Fold and unfold top. Valley fold bottom. Flip over.

8
Unfold everything.

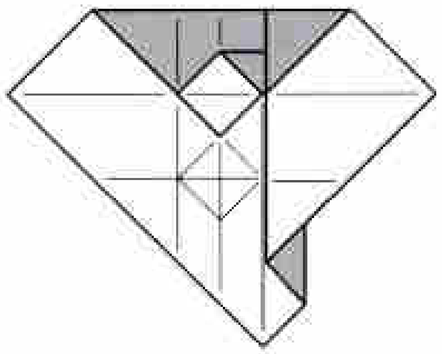




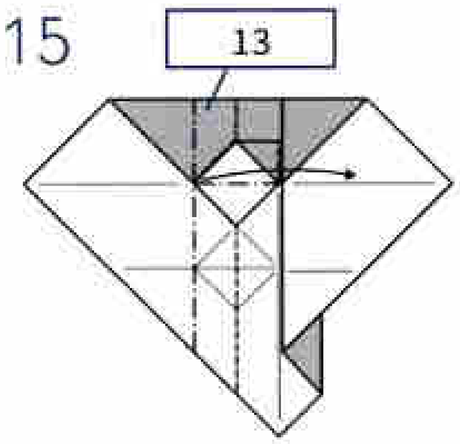
13



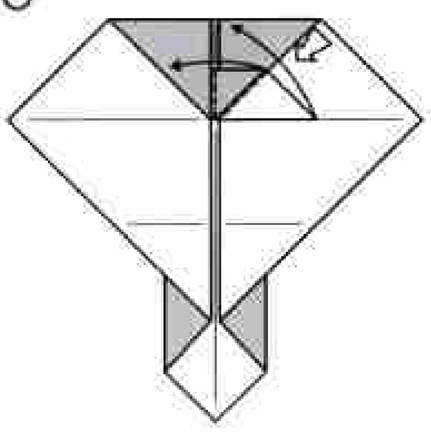
14



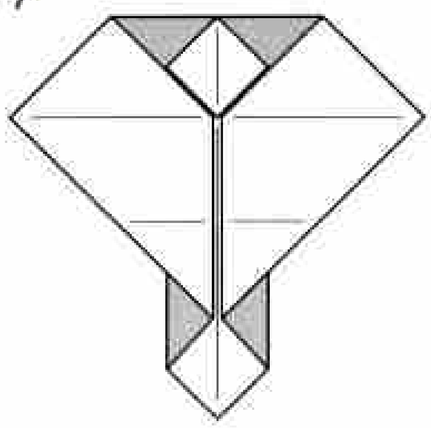
15



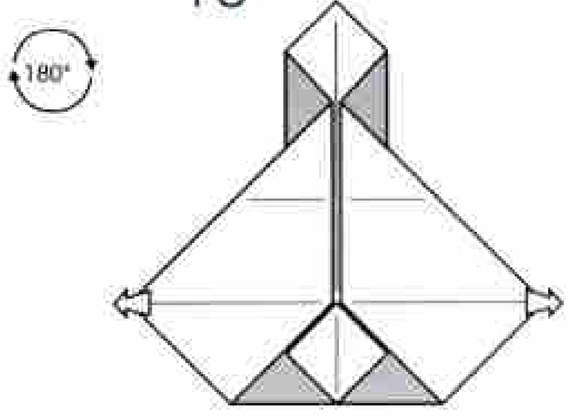
16



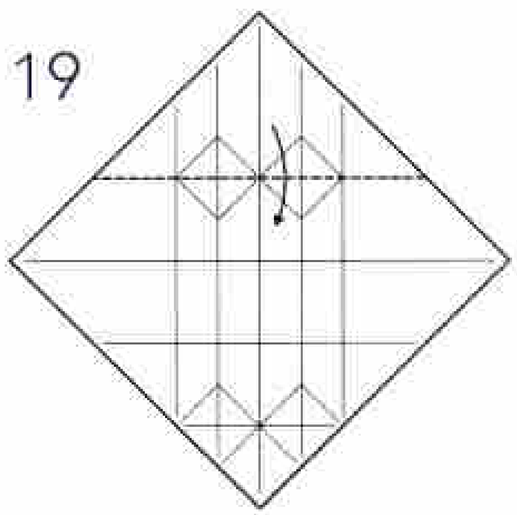
17



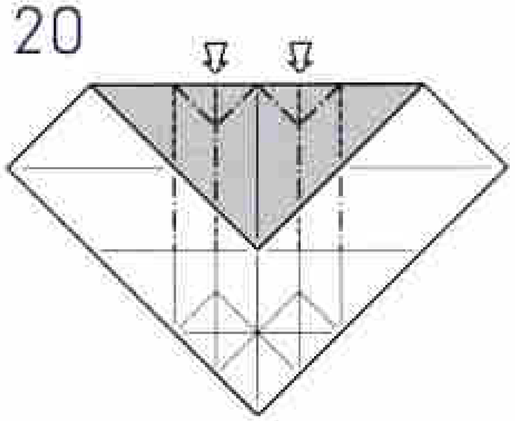
18



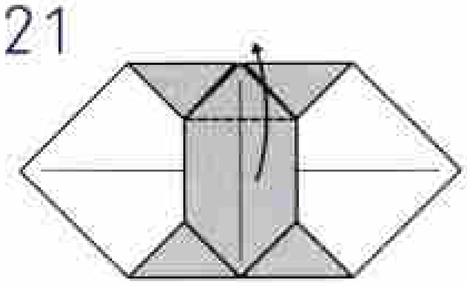
19



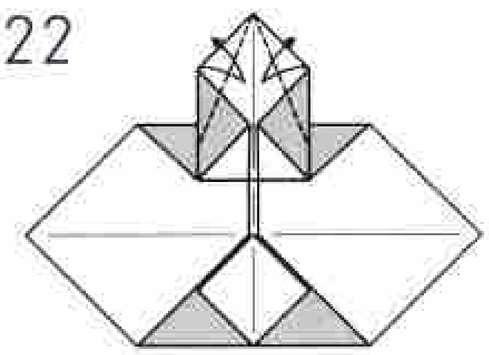
20



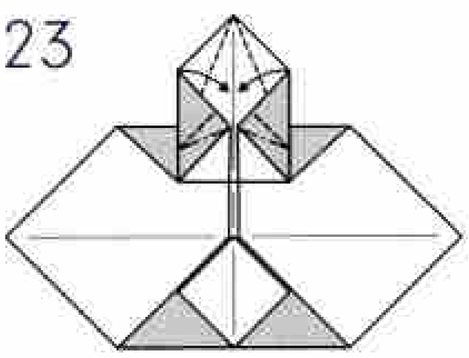
21



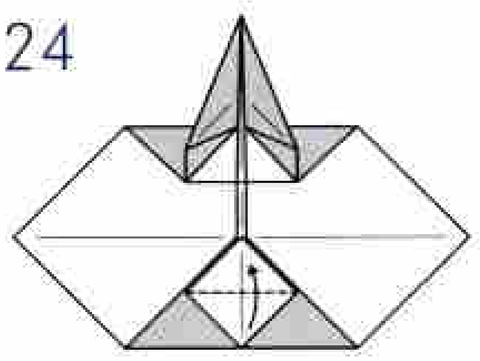
22



23



24



13
Pleat and reverse fold the flap.

15
Repeat step 13 on the left side.

16
Squash.

18
Unfold bottom temporarily.

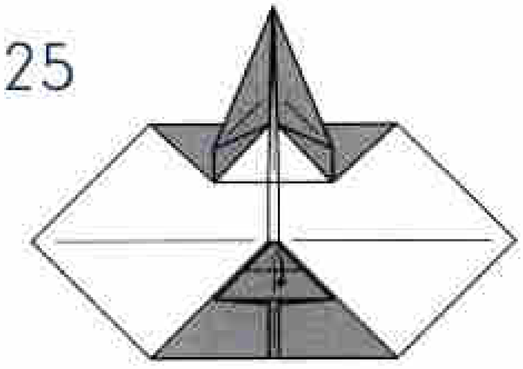
20
Collapse top and reconstruct bottom.

23
Rabbit ear folds.

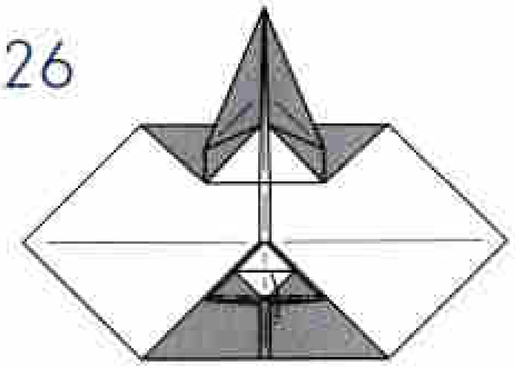
35
Inside reverse fold.

36
Repeat steps 29 to 35 on the left side.

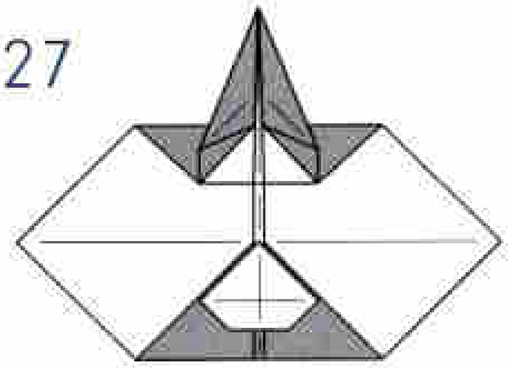
25



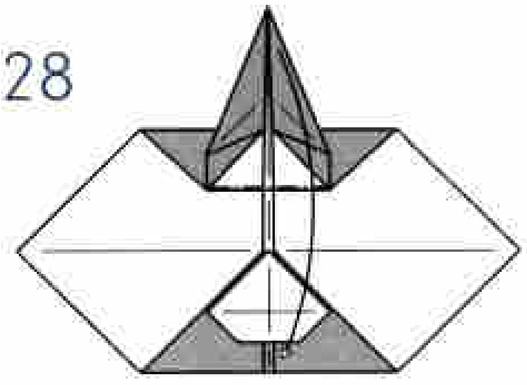
26



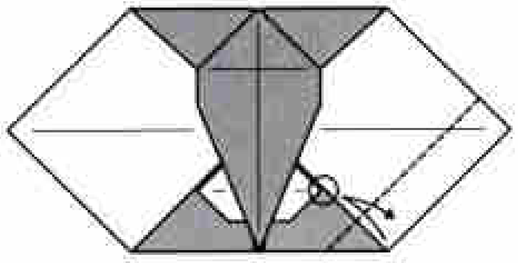
27



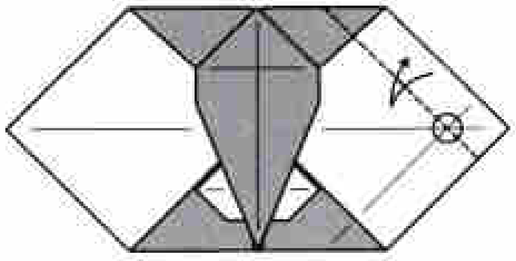
28



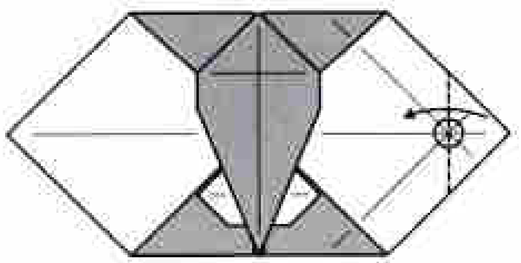
29



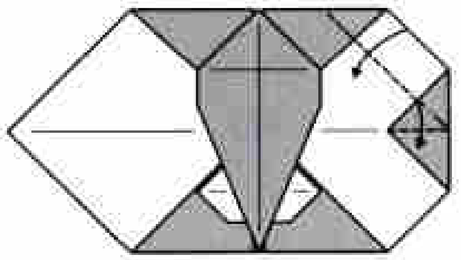
30



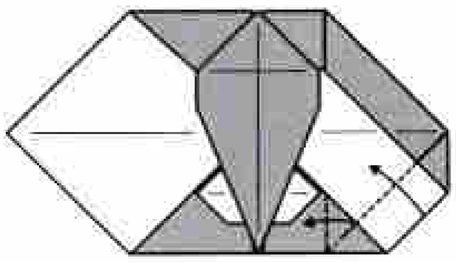
31



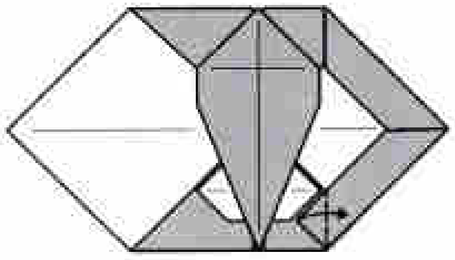
32



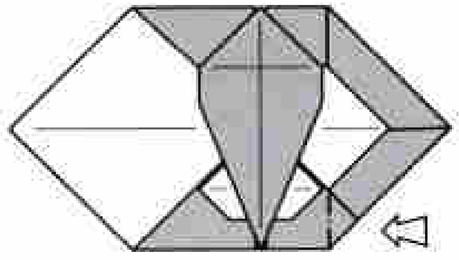
33



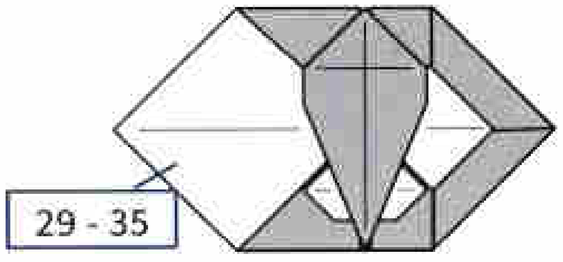
34



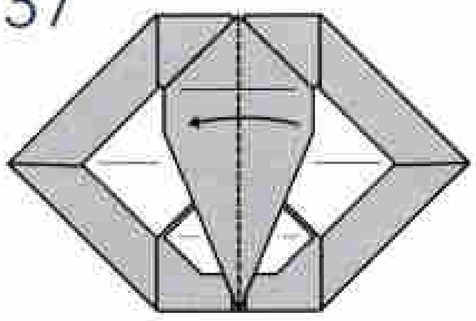
35



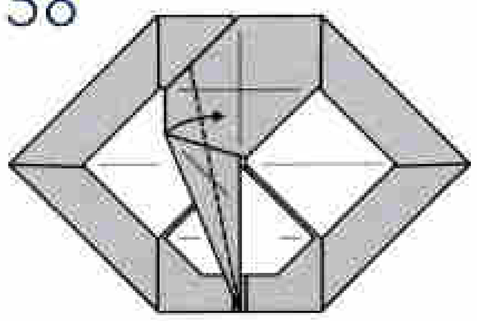
36



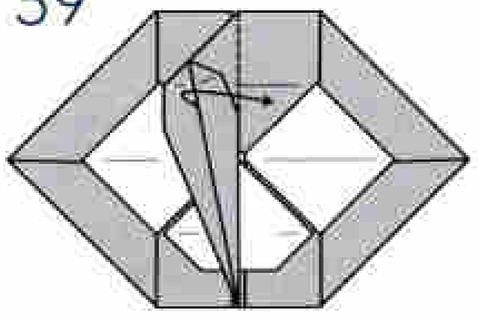
37



38



39



41

Repeat steps 37 to 40 on the left side.

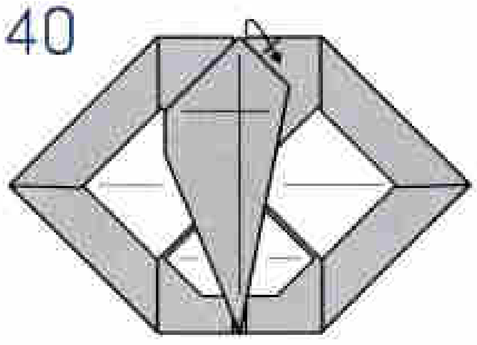
46

Shape.

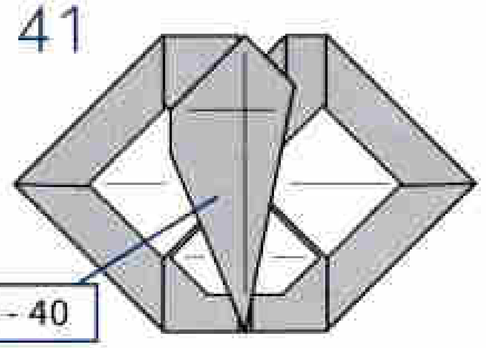
47

Stingray completed.

40

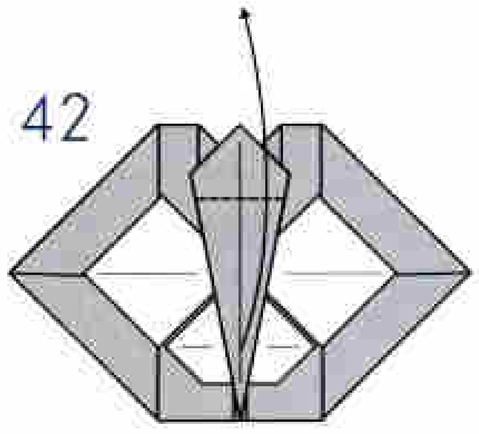


41

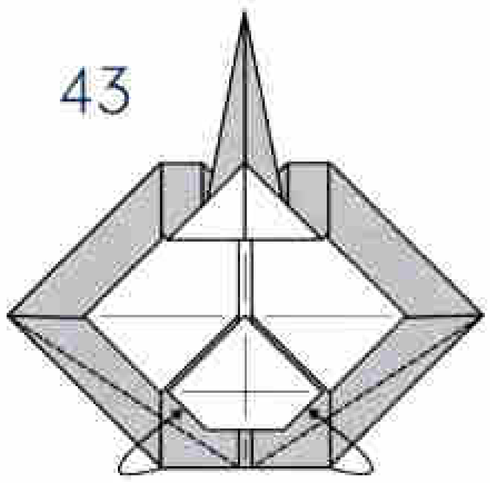


37 - 40

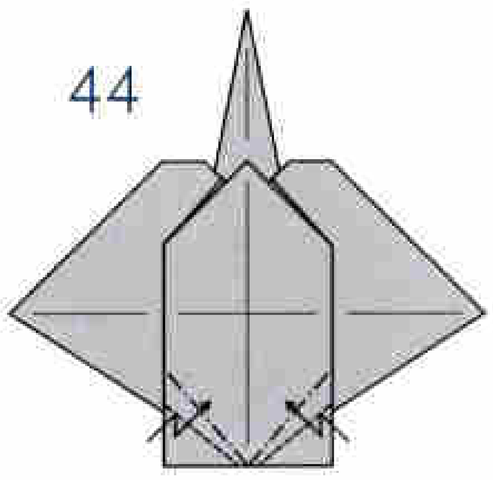
42



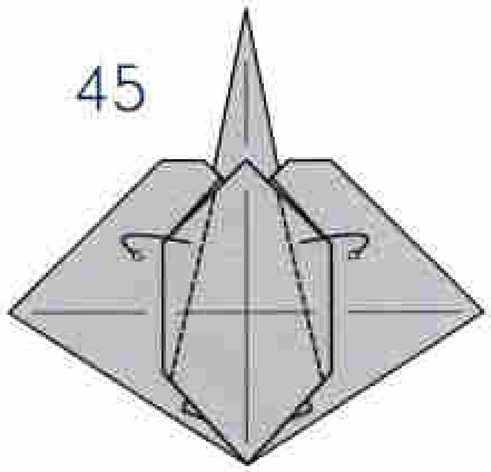
43



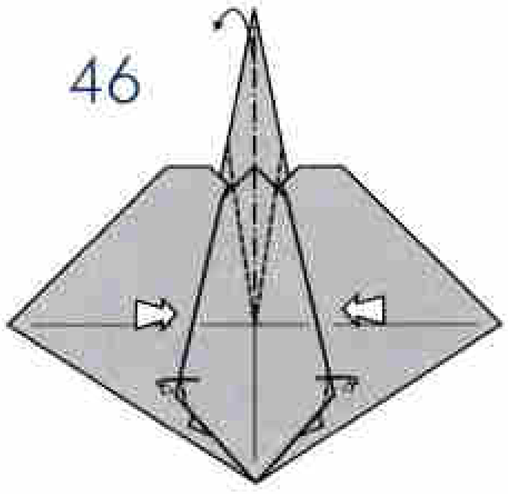
44



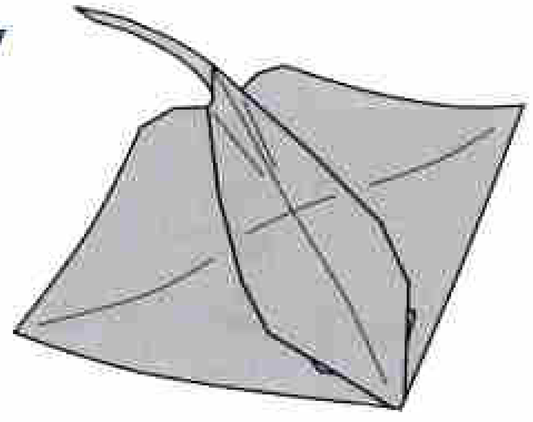
45



46



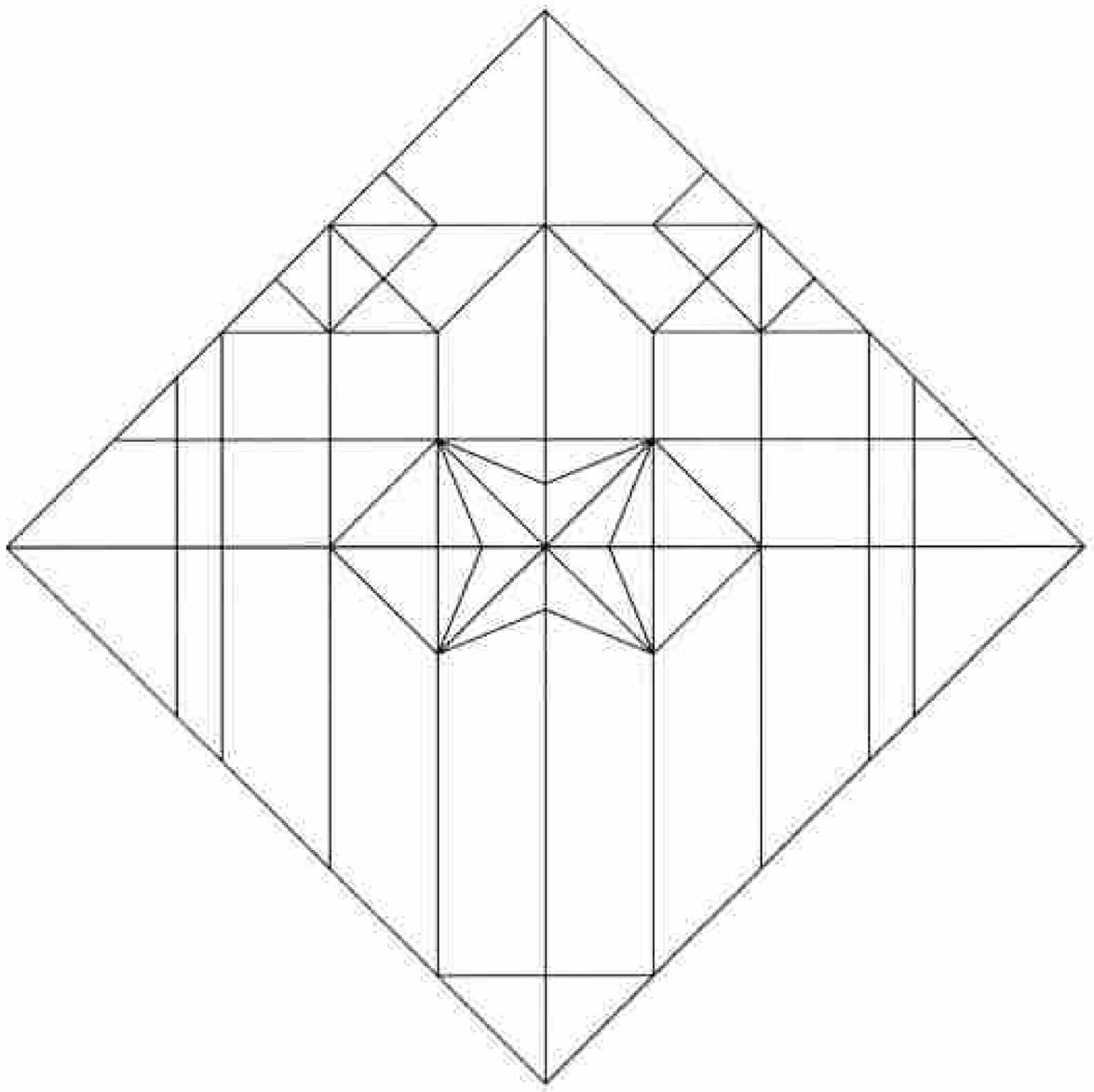
47

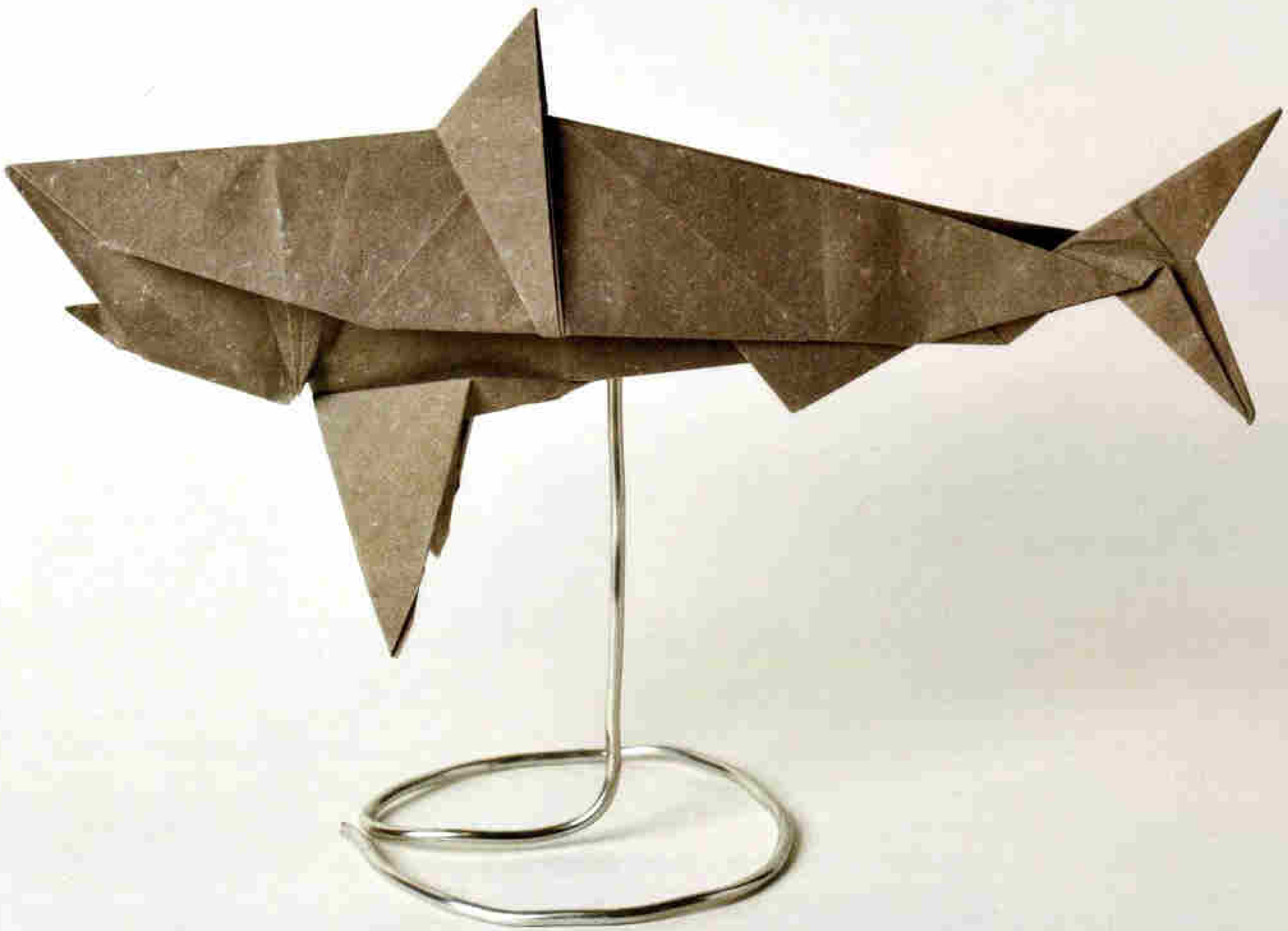


Great White Shark

Free-folding with a small piece of paper, I realized I could create a shark design with the dorsal fin in the center of the paper and the pectoral fins on opposite corners. With that established, it was only a matter of choosing the right grid. I chose a ten by ten grid which fit the model well. Conveniently, there was extra paper at the head area that I could fold into the five gills. The belly was locked by sinking one side and inserting the other side into the resulting pocket. Rather than implementing a color change for the lighter underbelly, I substituted the look with the edge of a layer.

When designing a model like this, it is tempting to create rows of teeth. However, I feel like emphasizing this particular feature reinforces the misguided belief that sharks are dangerous predators. In reality, sharks are beautiful, generally docile marine creatures and perhaps do not deserve the fear that they receive. One thing I should mention here is that according to a report published in early 2021, there has been a 71% decline in global abundance of sharks and rays since 1970, mostly due to increased fishing pressure. This massive decline has increased the risk of extinction for three-quarters of these species.

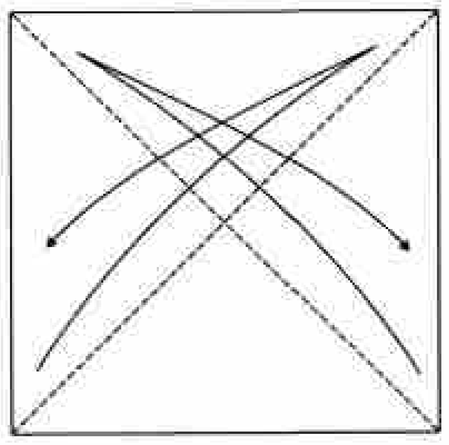




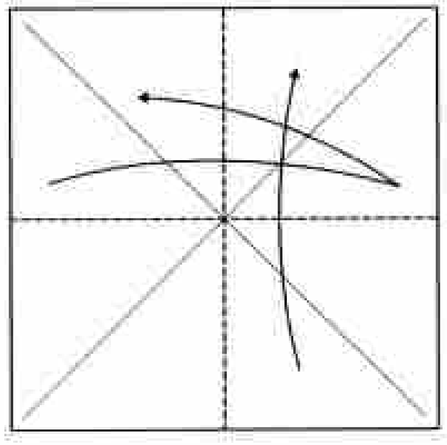
8

Valley folds.
Unfold everything.

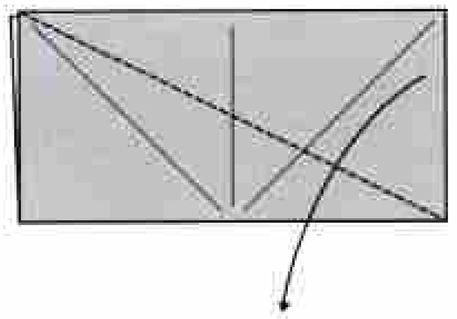
1



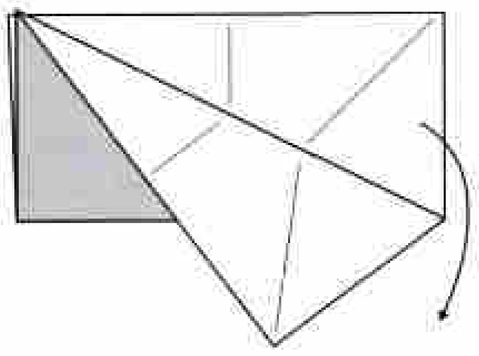
2



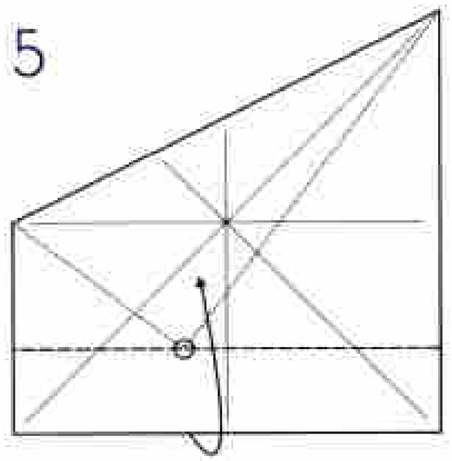
3



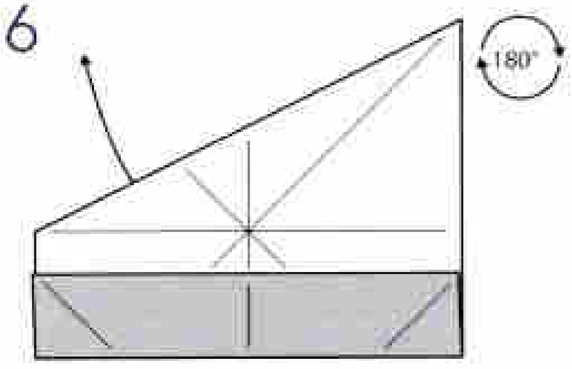
4



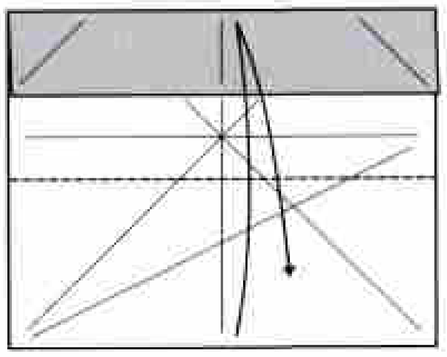
5



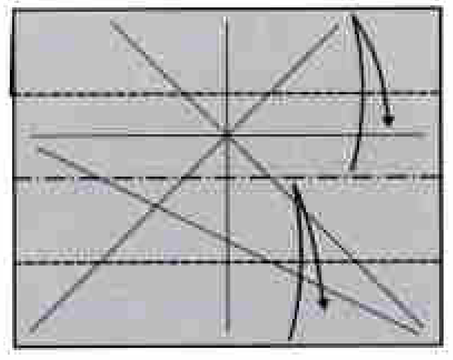
6



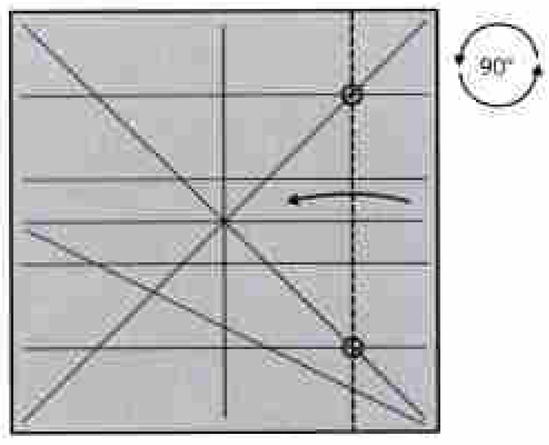
7



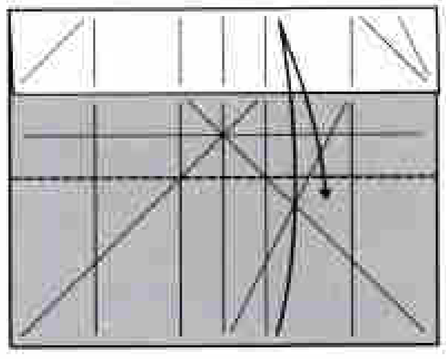
8



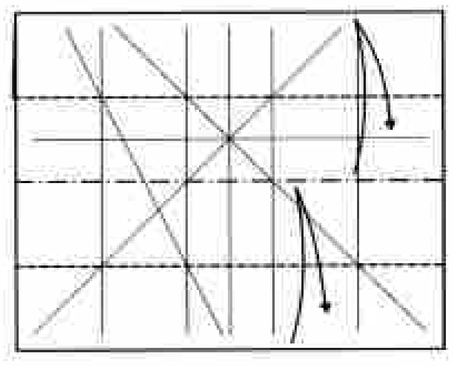
9



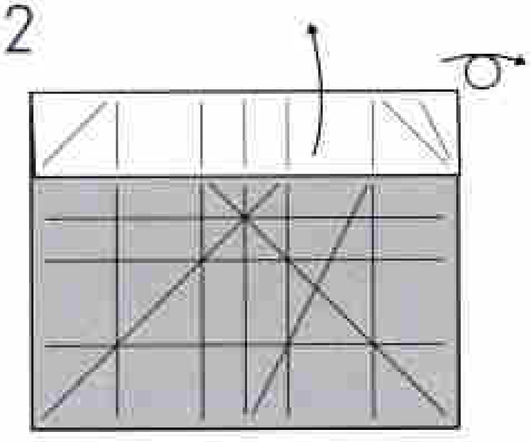
10



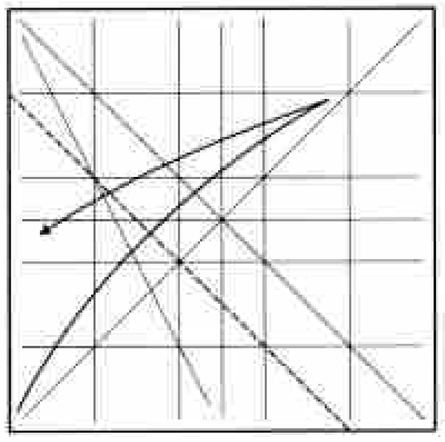
11



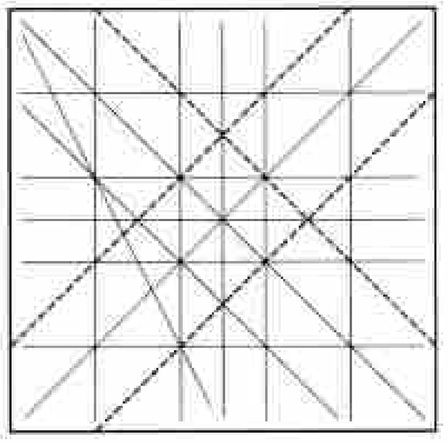
12



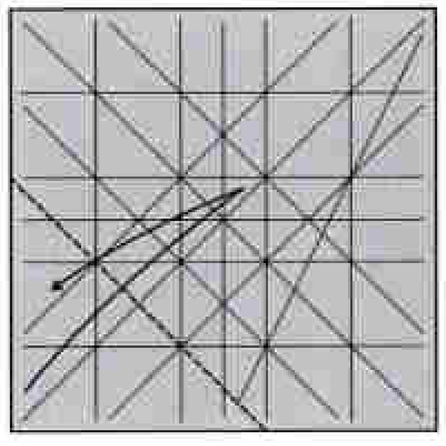
13



14



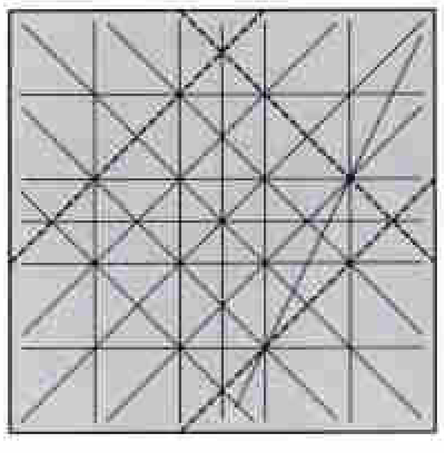
15



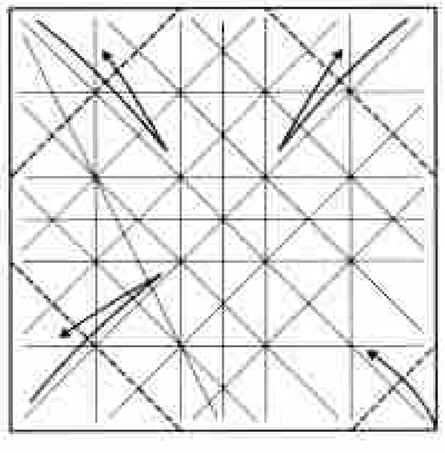
20

Fold and unfold.
Unfold to step
19.

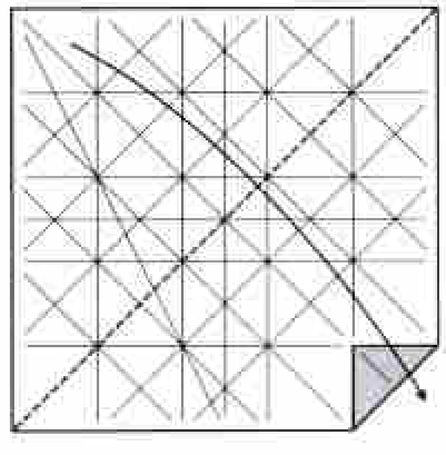
16



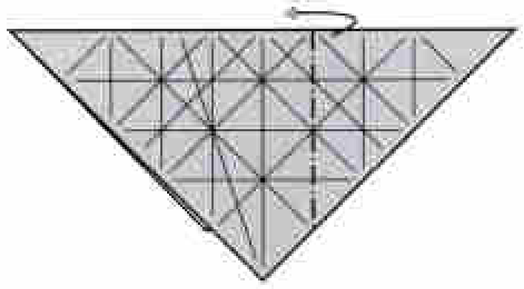
17



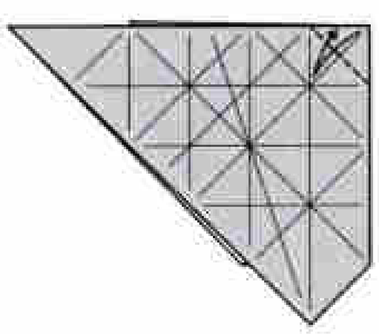
18



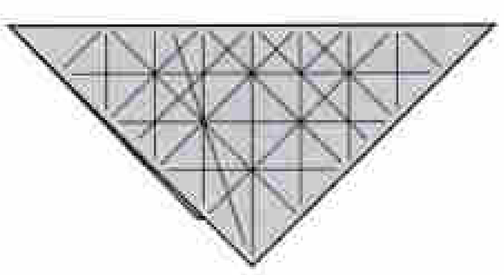
19



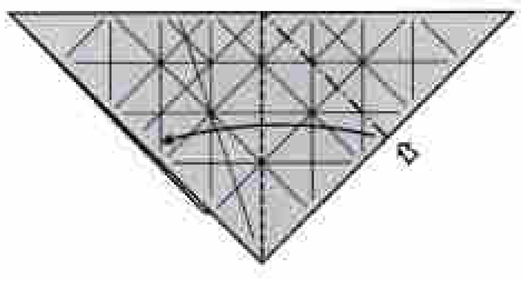
20



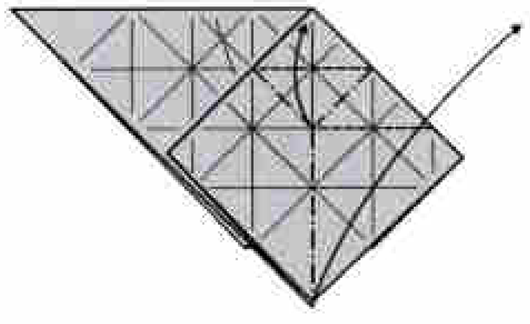
21



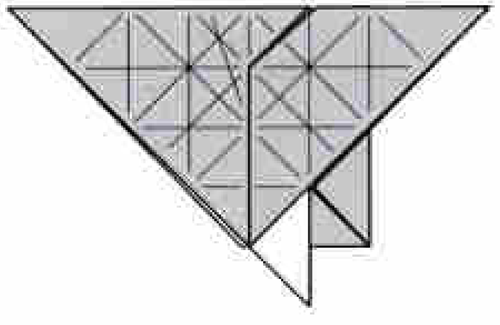
22



23



24



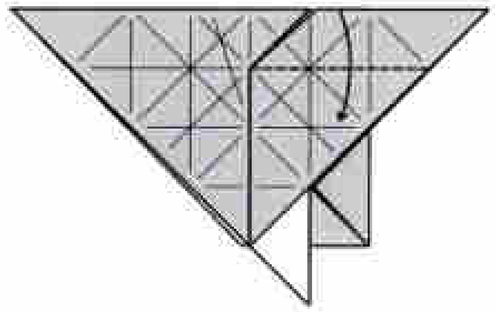
28
Repeat steps 19 to 27 on the left side.

30
Inside reverse fold.

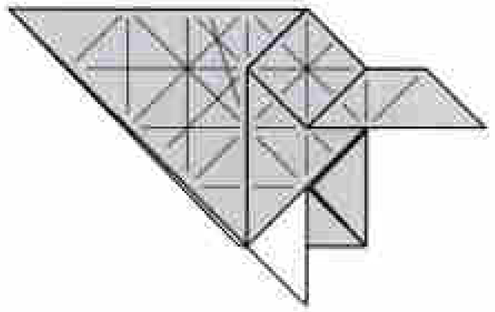
32
Pull out paper.

36
Valley fold slightly past midline.

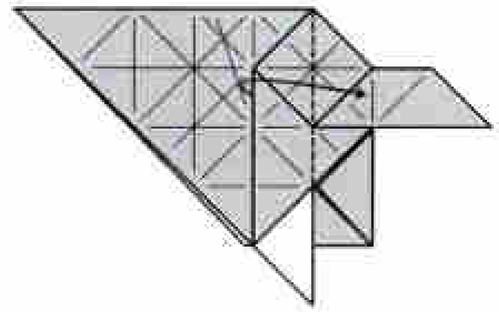
25



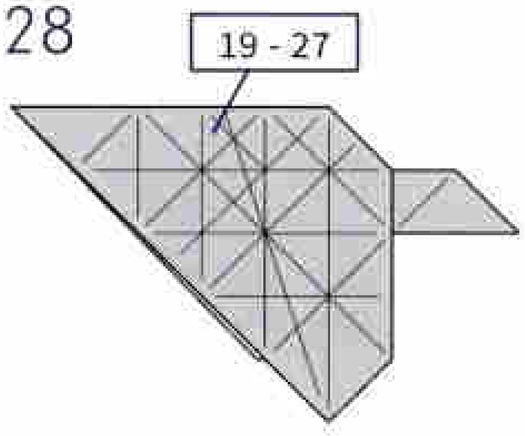
26



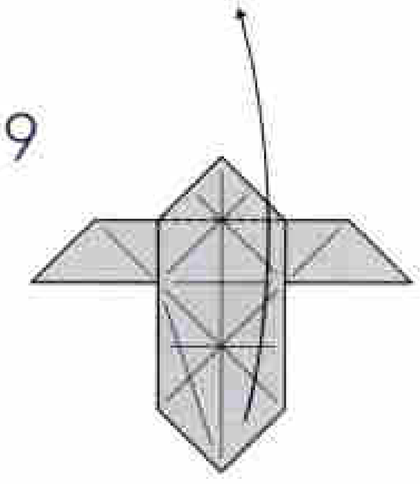
27



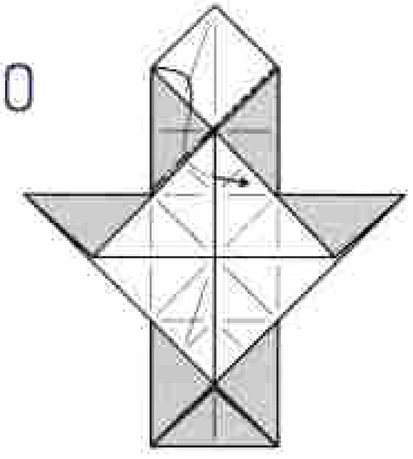
28



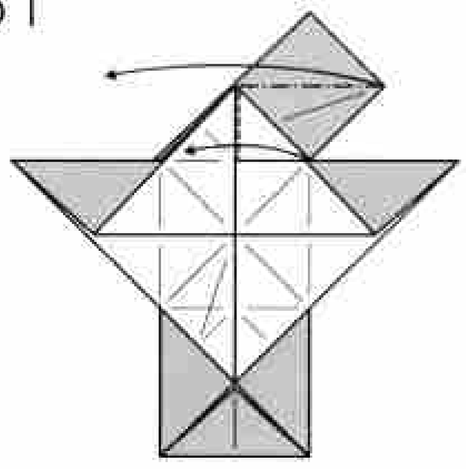
29



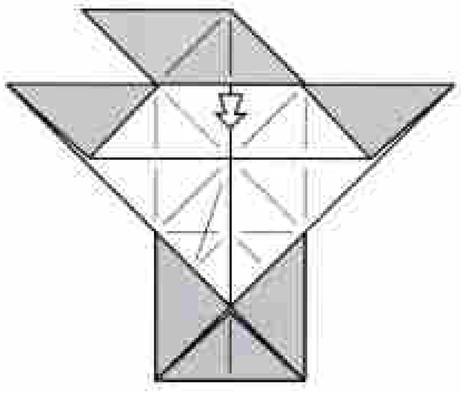
30



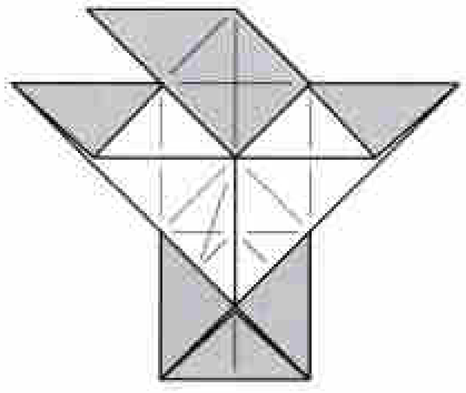
31



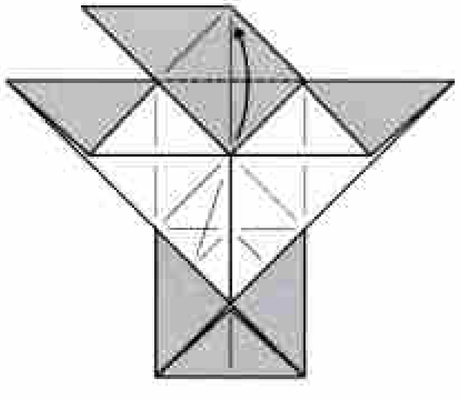
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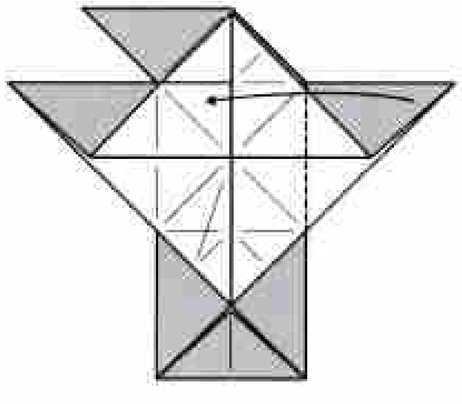
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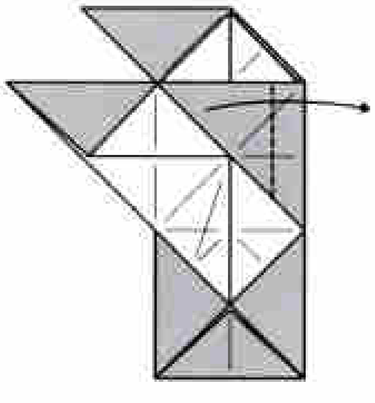
34



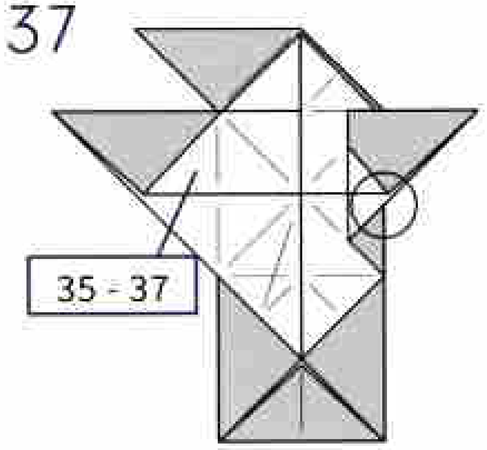
35



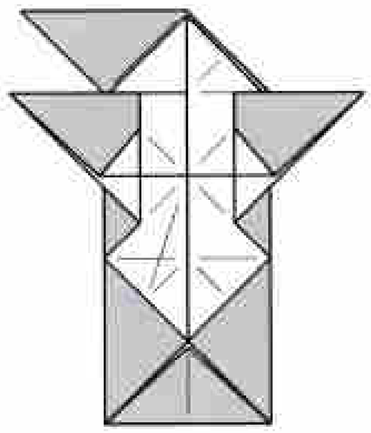
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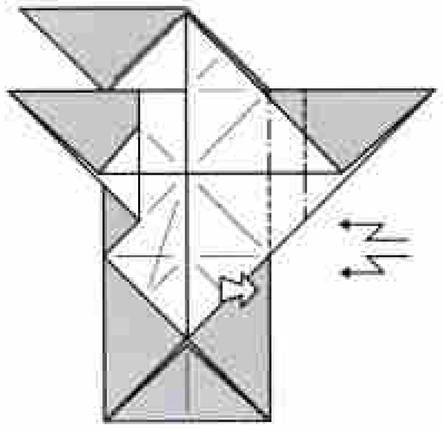
37



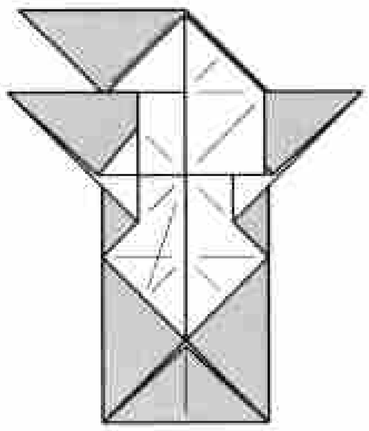
38



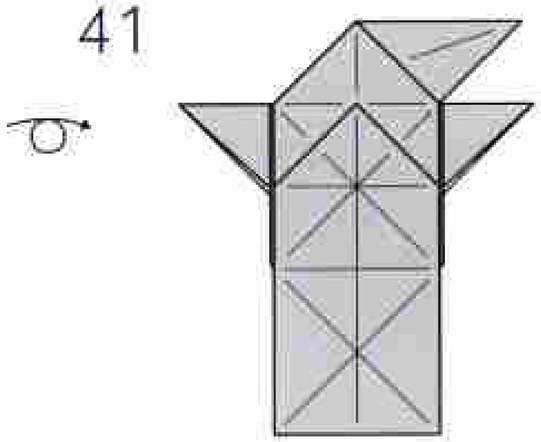
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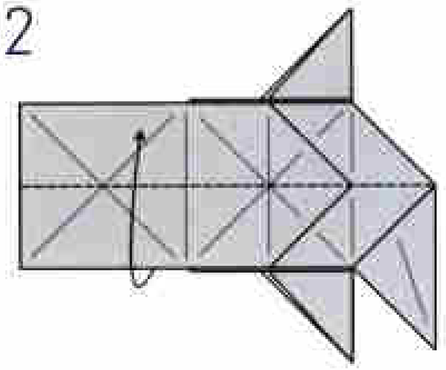
40



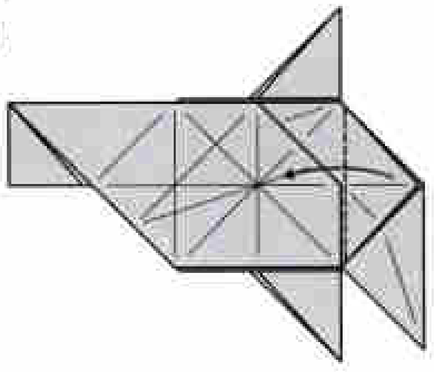
41



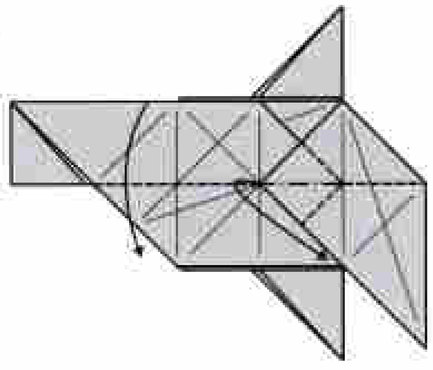
42



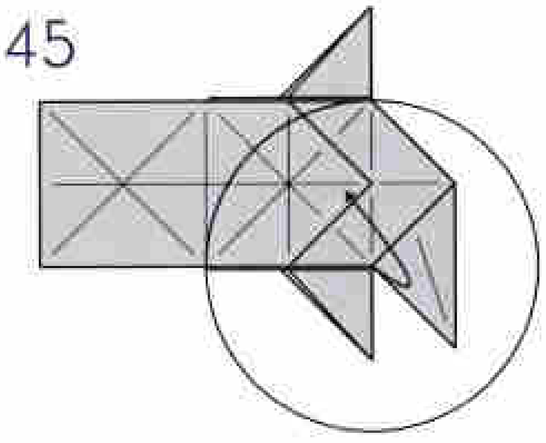
43



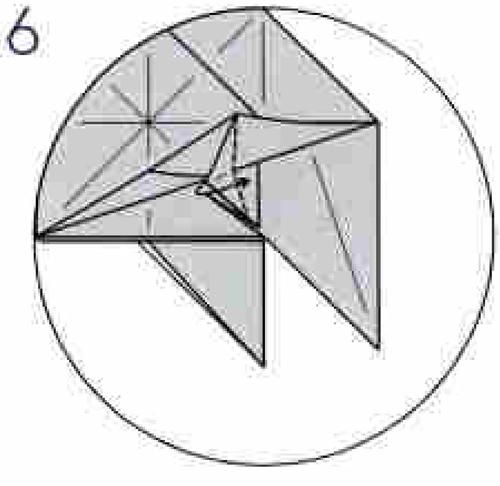
44



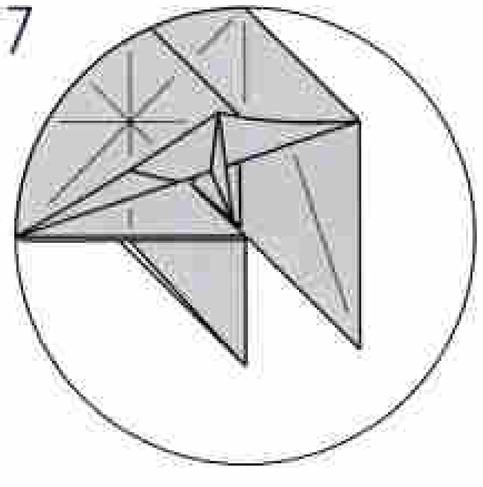
45



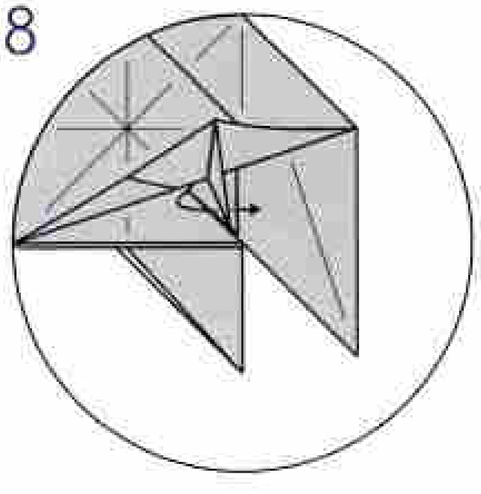
46



47



48



37
Valley fold completed. Crease extends past edge slightly. Repeat steps 35 to 37 on the left side.

39
Pleat flap inside. Pull out the paper at the arrow to make it easier.

40
Do not repeat on left side. Flip over.

45
Lift flap. Do not crease.

46
Petal fold. Leave a gap.

48
Reverse fold inner flap past the edge.

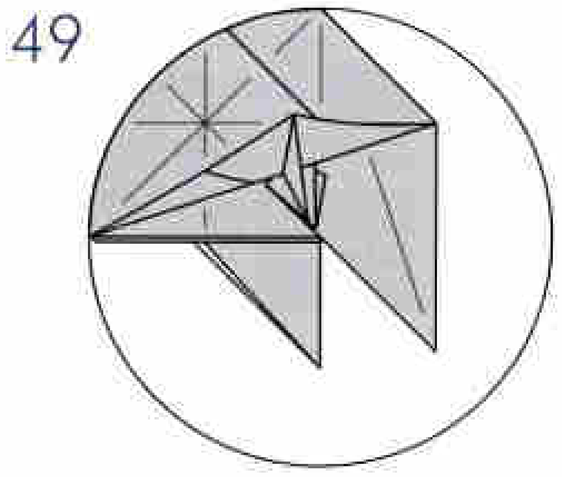
50
Valley fold.

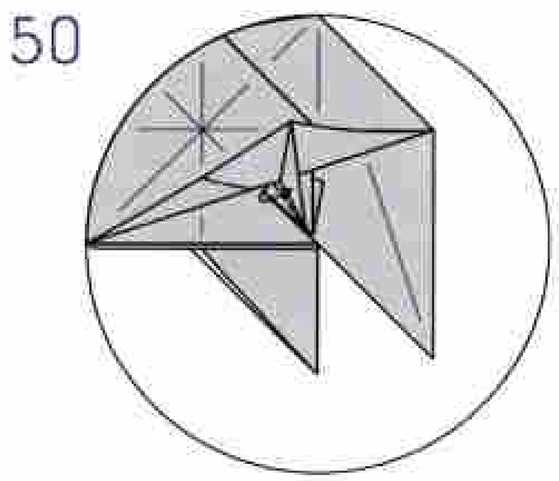
51
Gills completed.

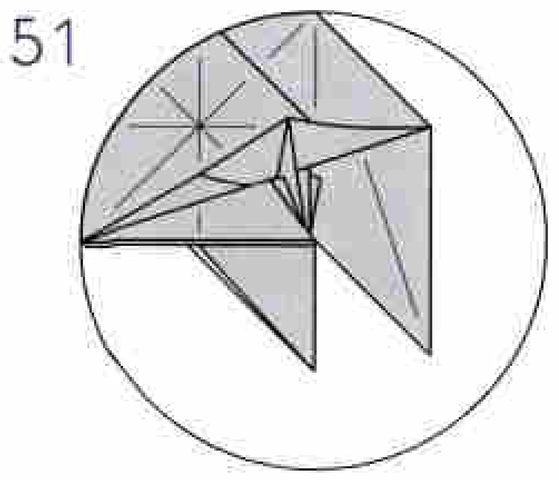
52
Close model.

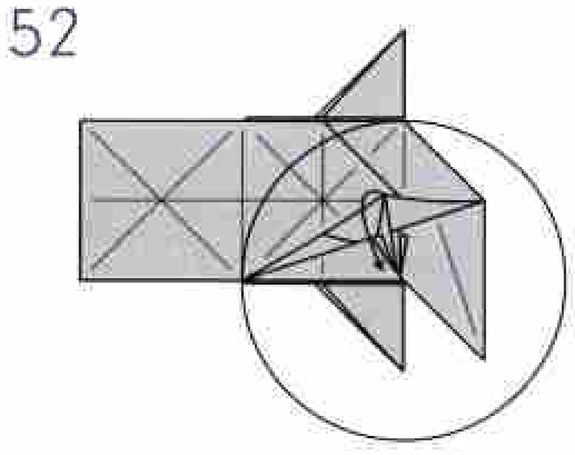
53
Repeat steps 42 to 52 on the other side.

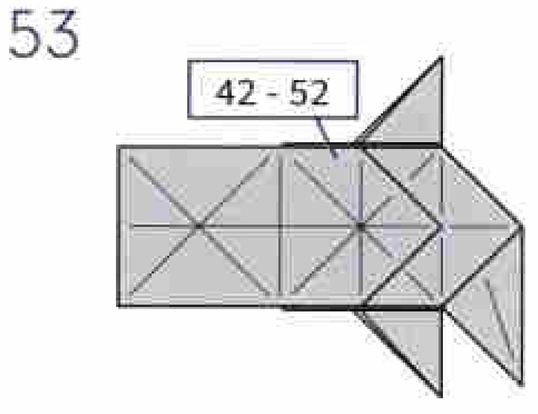
54
Rabbit ear fold and fold model in half.

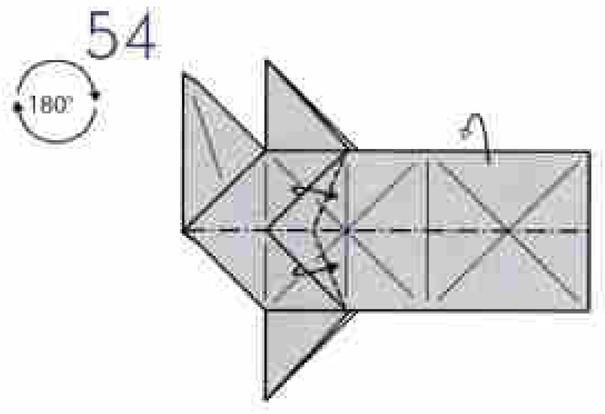


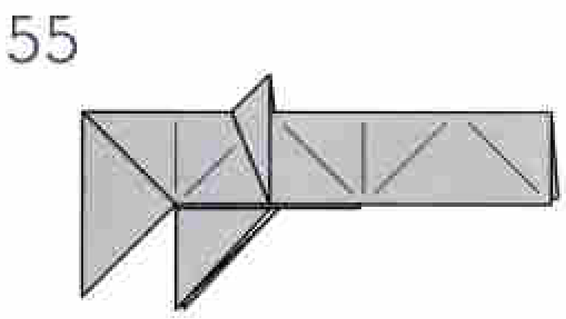


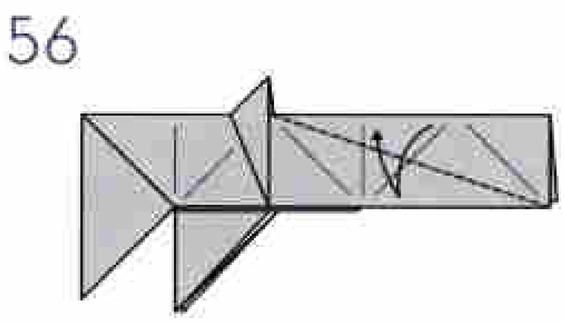


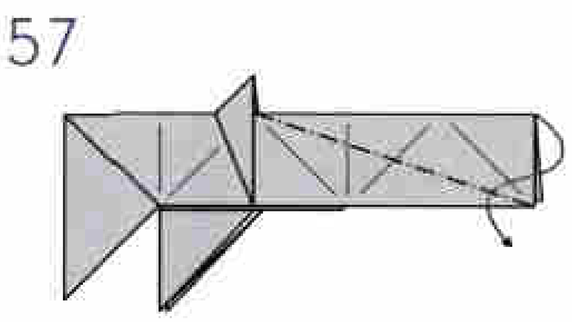


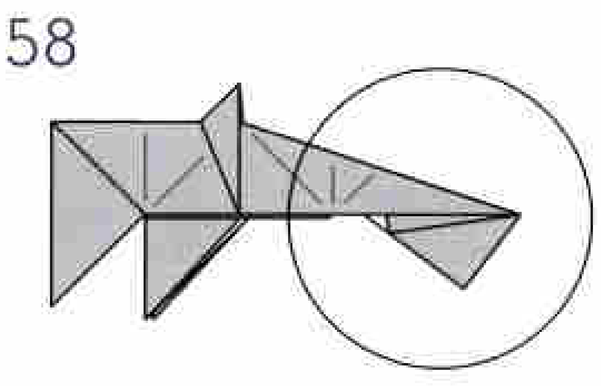


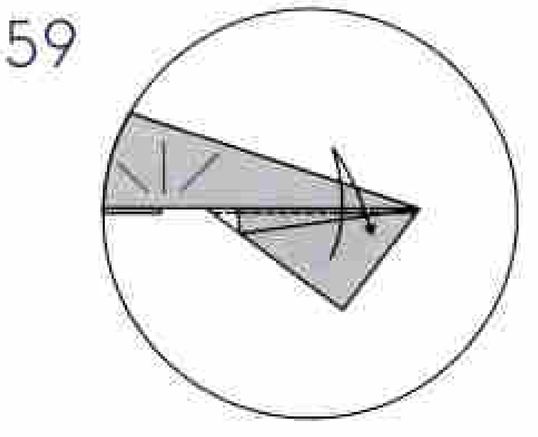


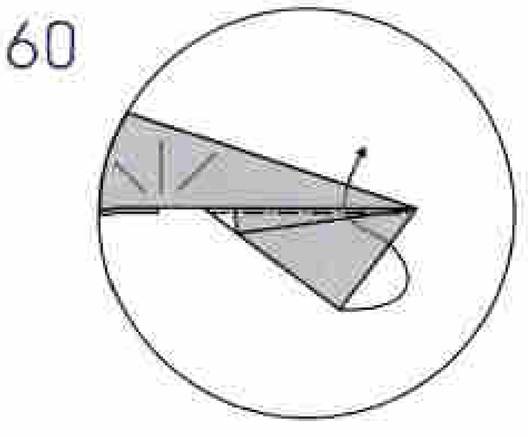




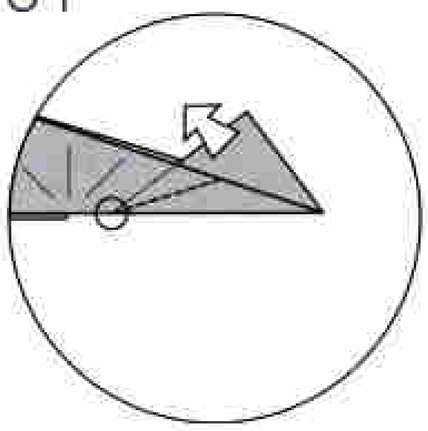




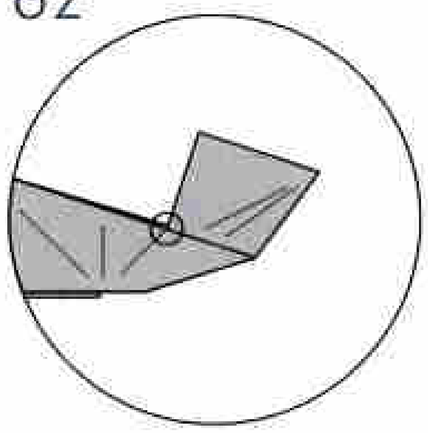




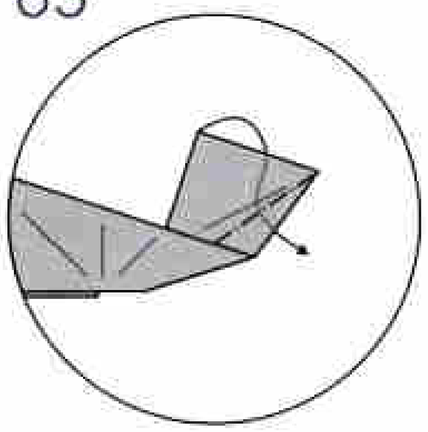
61



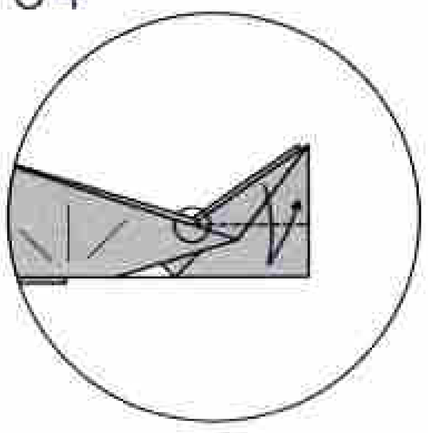
62



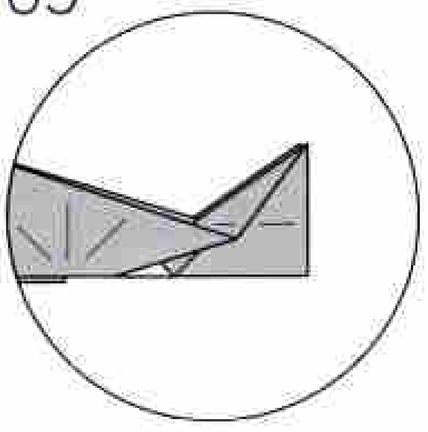
63



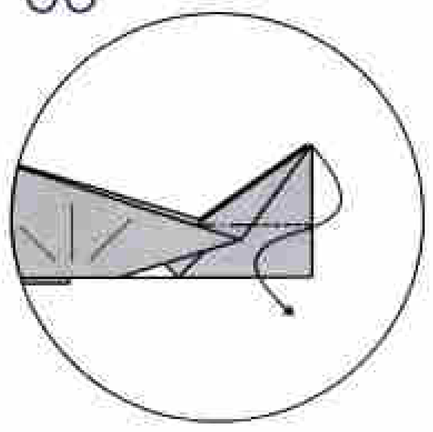
64



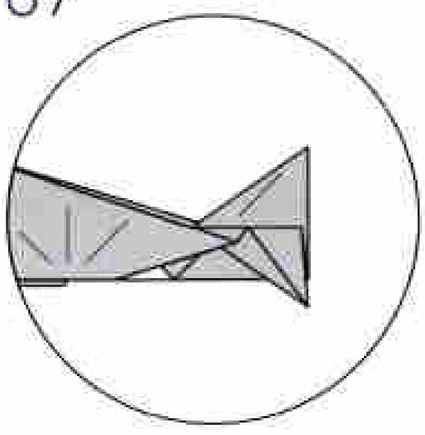
65



66

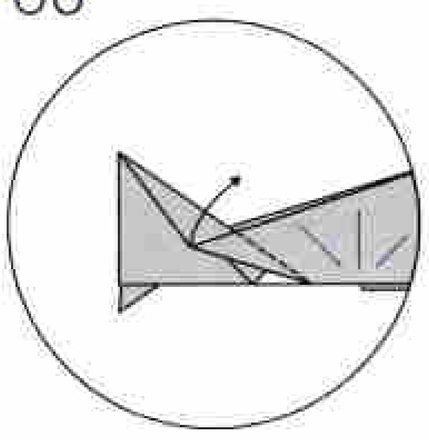


67

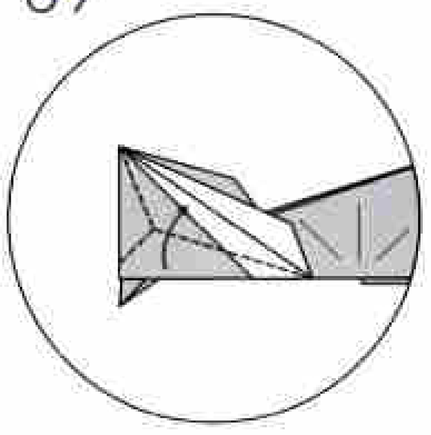




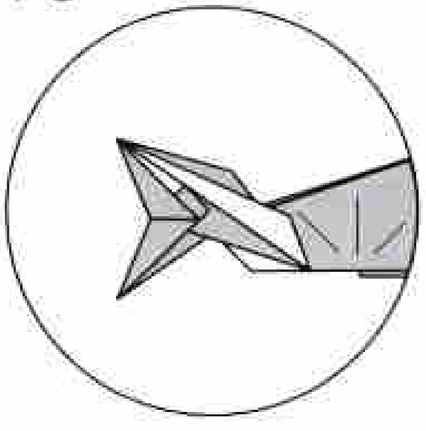
68



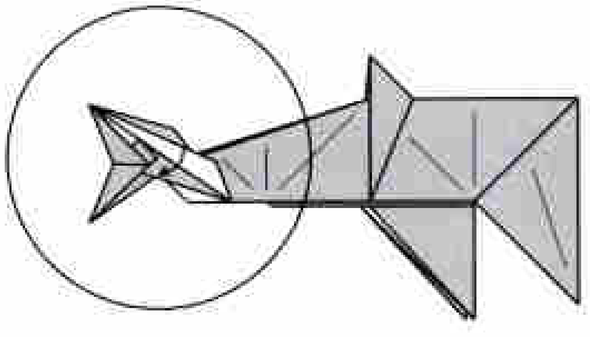
69



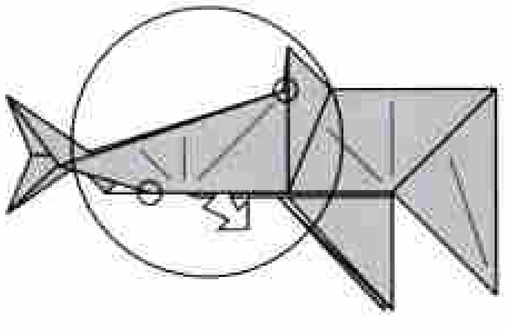
70



71



72



61
Swivel on reference point to reference point in step 62.

66
Inside reverse fold.

69
Two rabbit ear folds.

72
Swivel inner flap out on the reference point behind dorsal fin as far as possible until it reaches the second reference point.

73
Swivel completed.

74
Mountain fold. Repeat steps 72 to 74 behind.

78
Unfold to step 75.

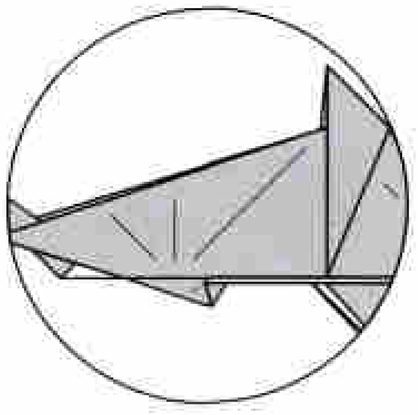
80
Crimp.

81
Mountain fold. Repeat behind.

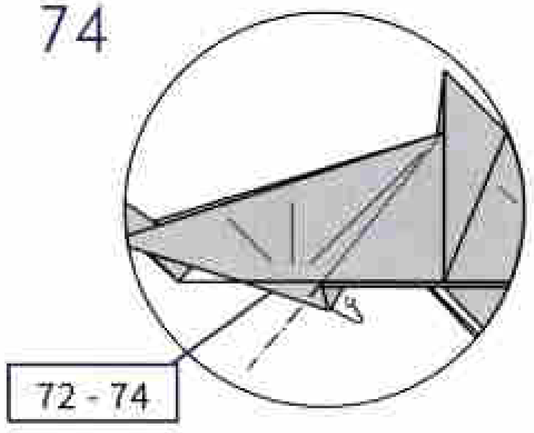
82
Mountain fold to reference line. Repeat behind.

84
Mountain fold. Use reference points. Repeat behind.

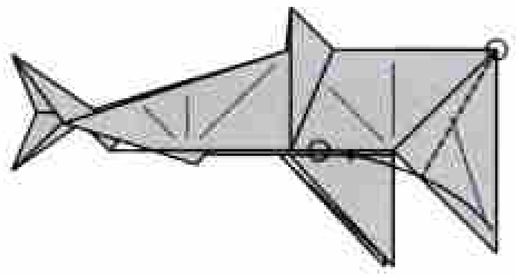
73



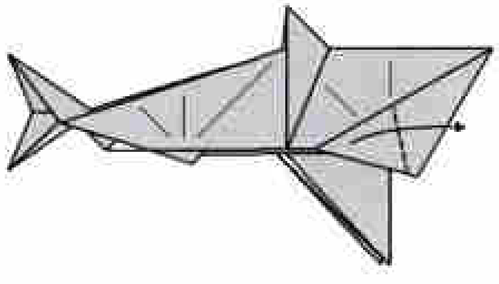
74



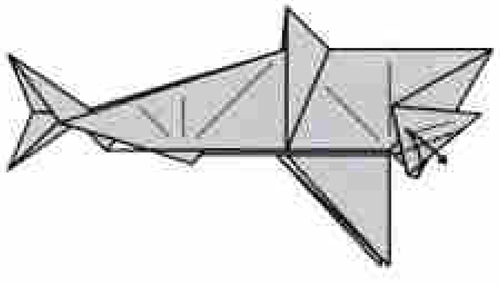
75



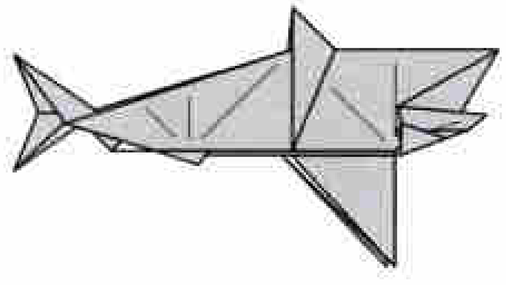
76



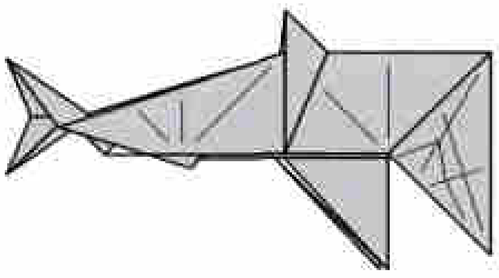
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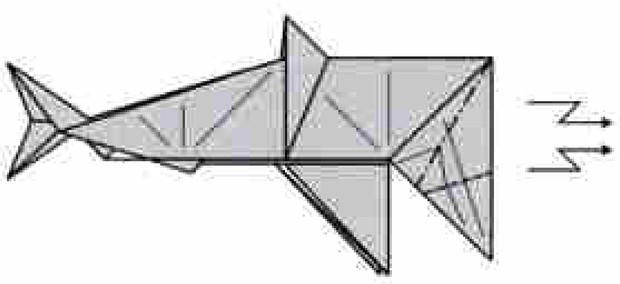
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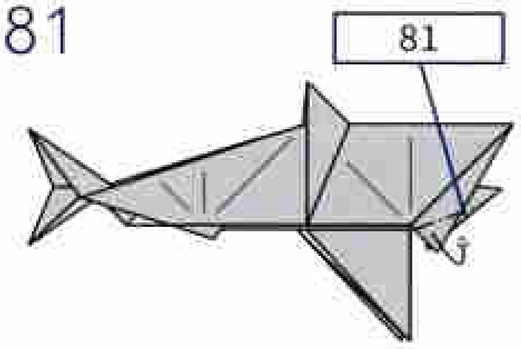
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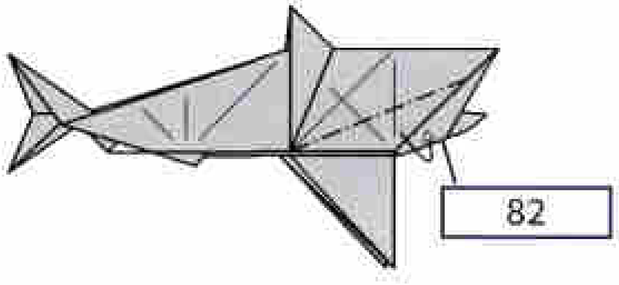
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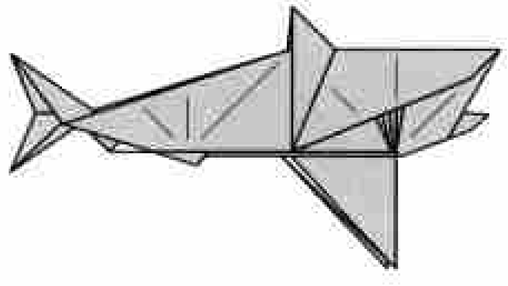
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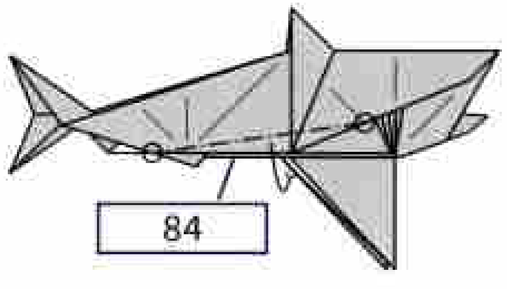
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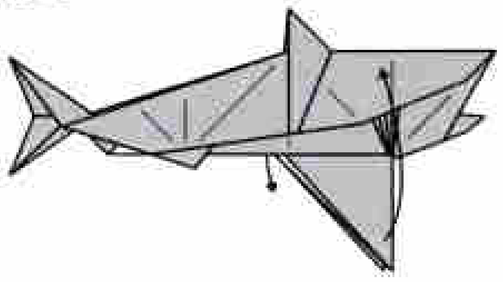
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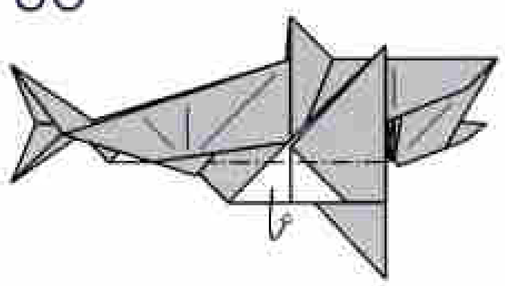
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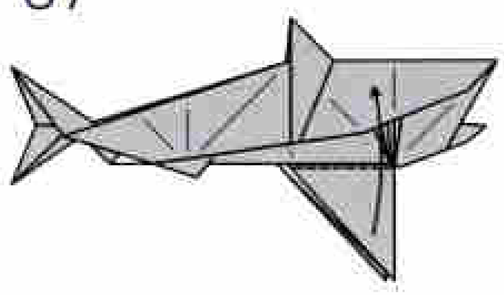
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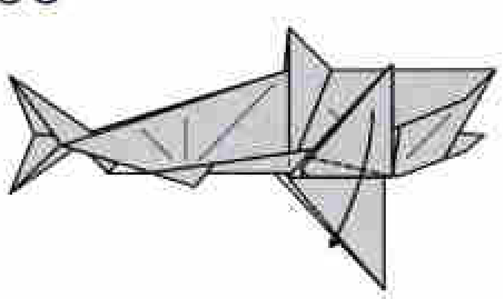
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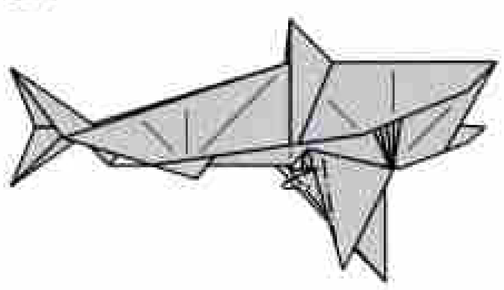
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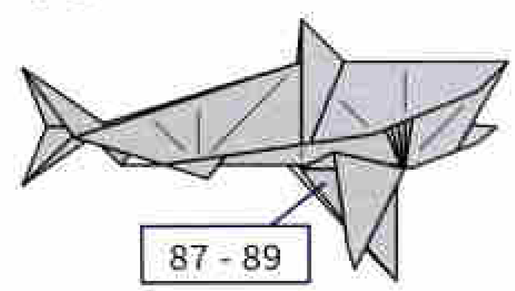
88



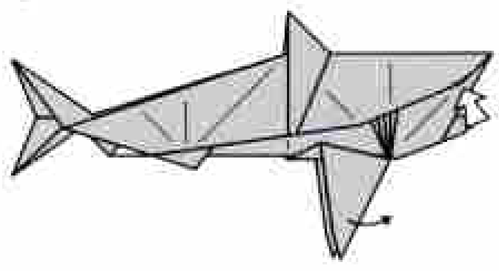
89



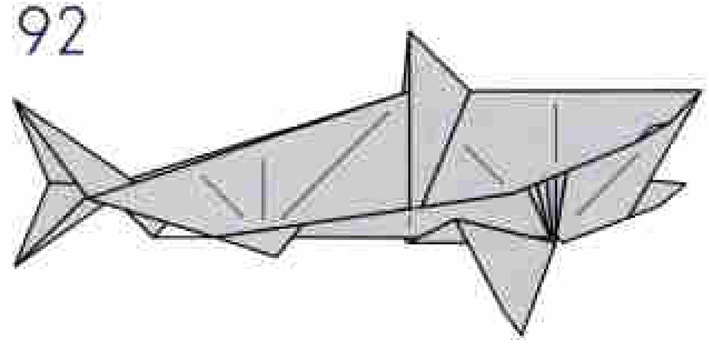
90



91



92



86
Insert flap into pocket behind.

89
Inside reverse fold.

90
Repeat steps 87 to 89 behind.

91
Shape.

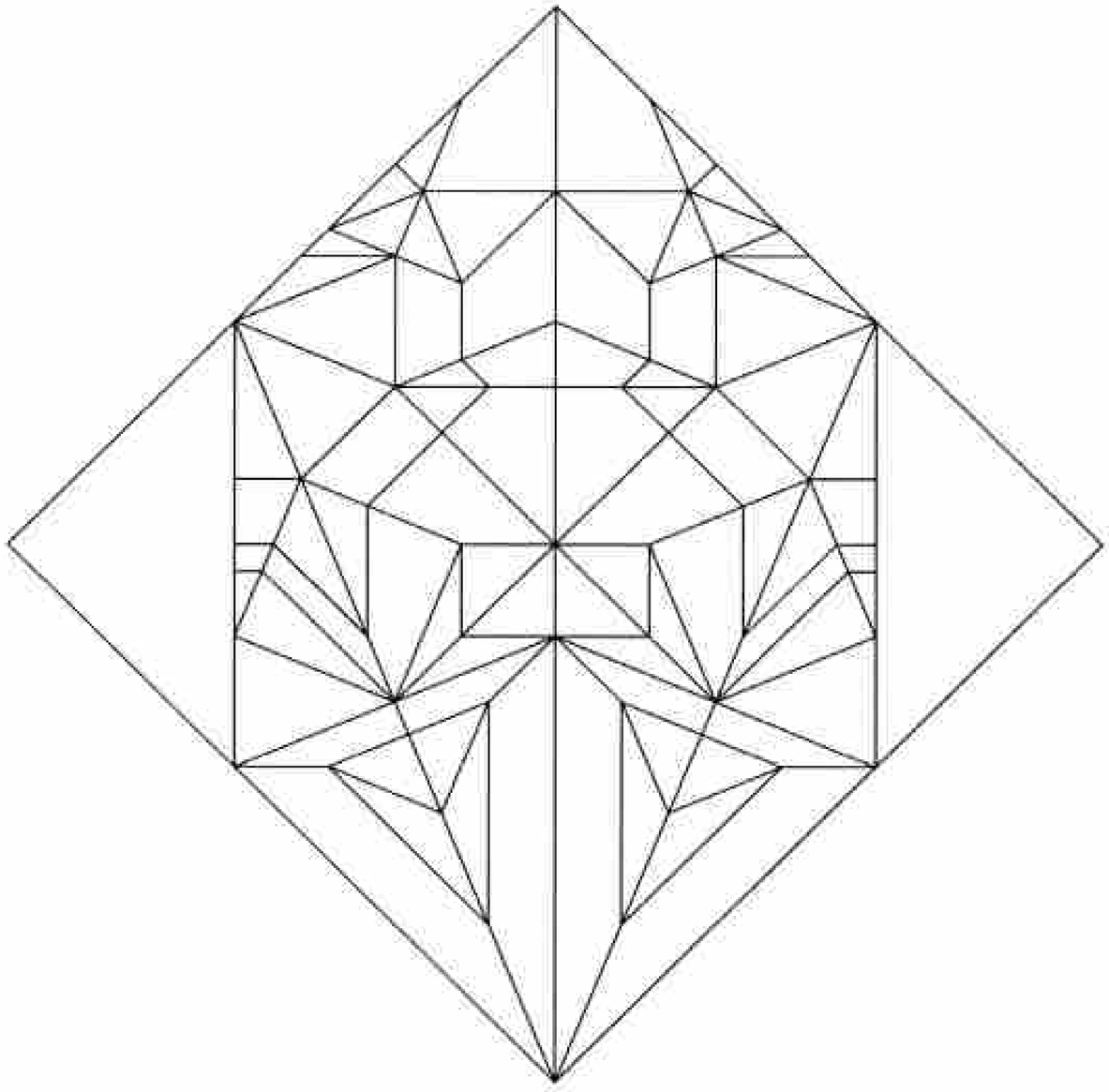
92
Great white shark completed.

Bull Shark

It is a good challenge to attempt a subject more than once. In this case, I had already designed a great white shark, but felt compelled to design a new species in a different style–22.5°, instead of grid based.

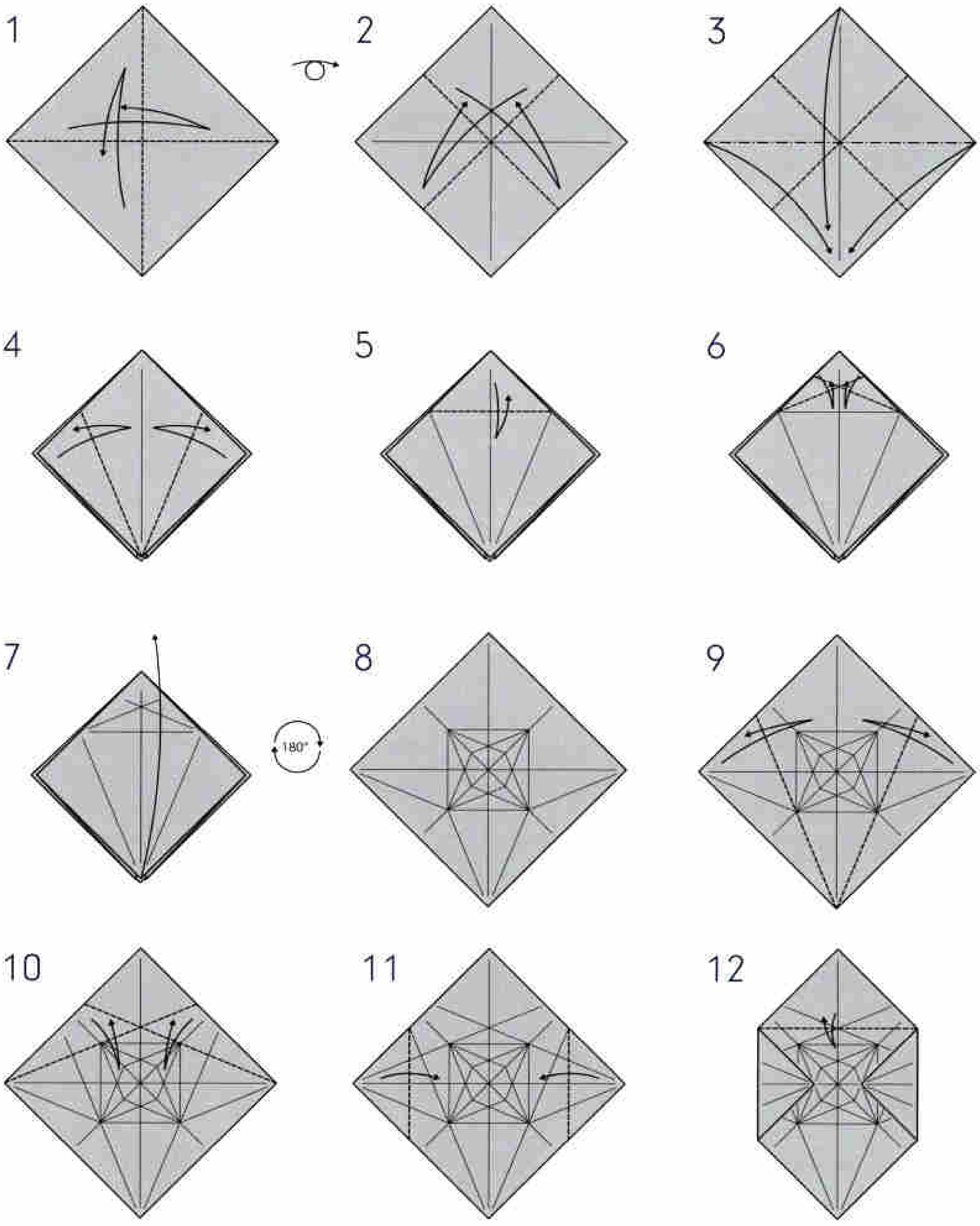
The bull shark is an excellent choice for a subject, with its uniquely aggressive, streamlined form. This model is loosely based on a kite base. I closely focused on the hierarchy and placement of the layers to best mimic the form of this shark. Each edge is positioned to define the muscle structure of the body. Careful observation of this piece will reveal additional hidden symmetries and repetitions within the lines.

Use one colored paper for this model.

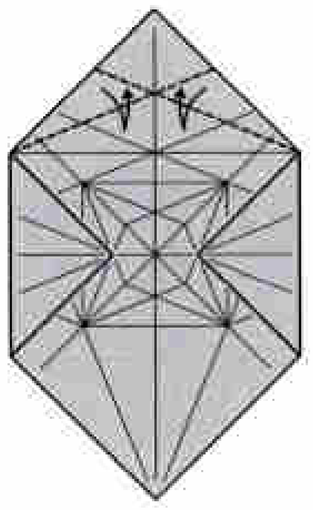




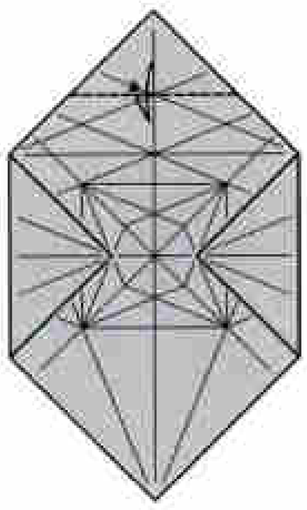
7
Unfold everything.



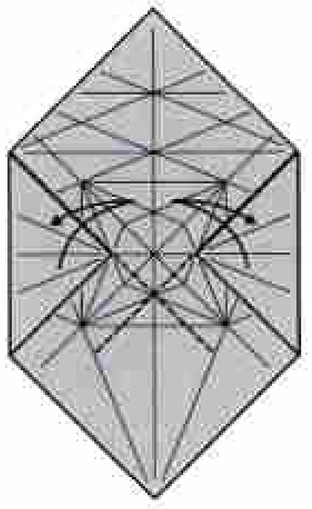
13



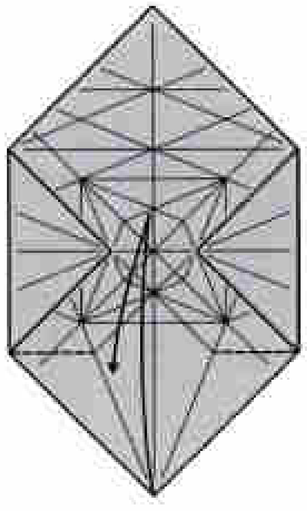
14



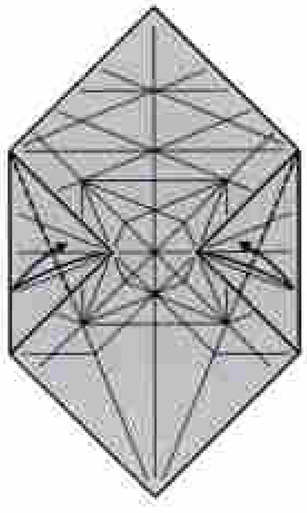
15



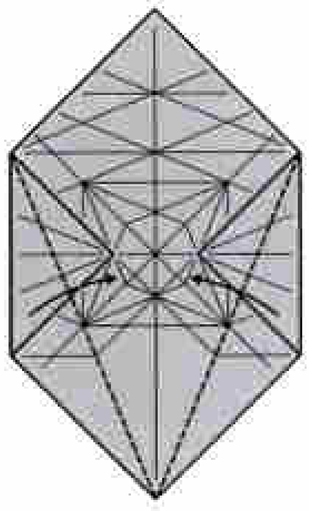
16



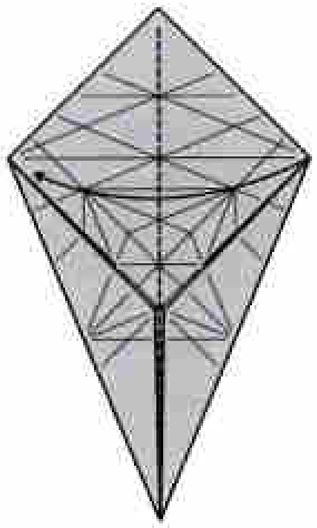
17



18

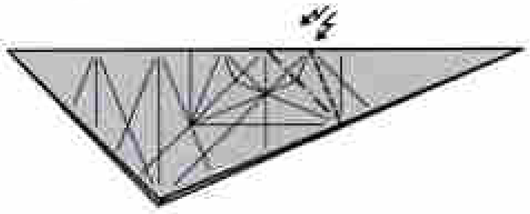


19

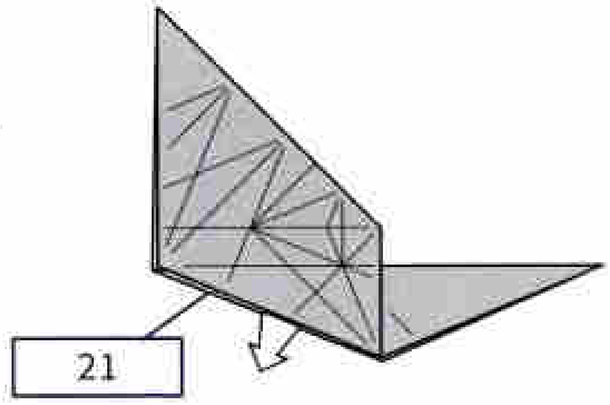




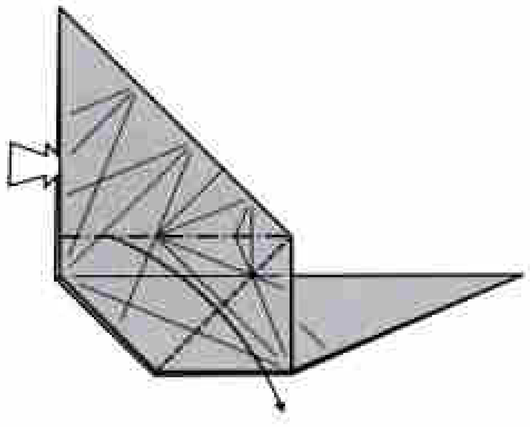
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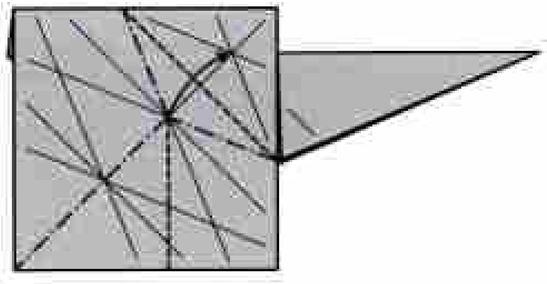
21



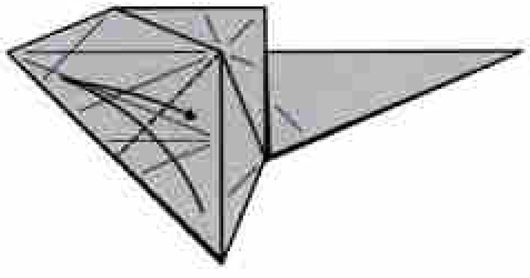
22



23



24



20
Crimp.

21
Pull out one layer. Repeat behind.

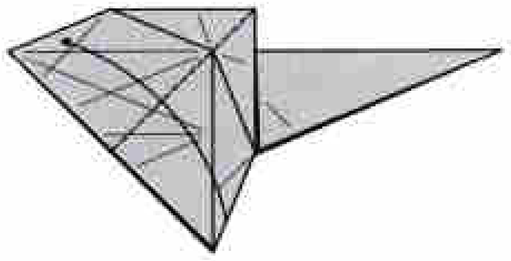
22
Squash.

26
Collapse as shown.

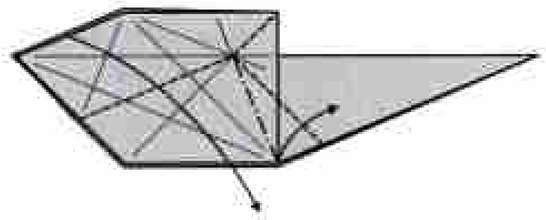
30
Squash and form a petal fold.

35
Repeat steps 26 to 34.

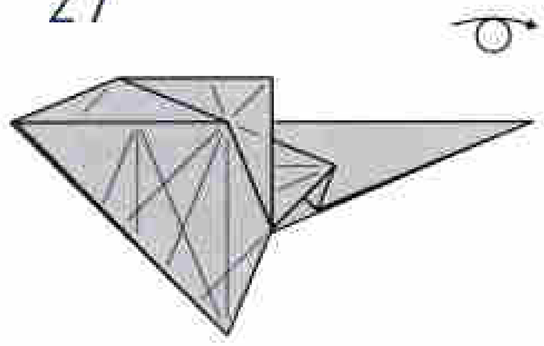
25



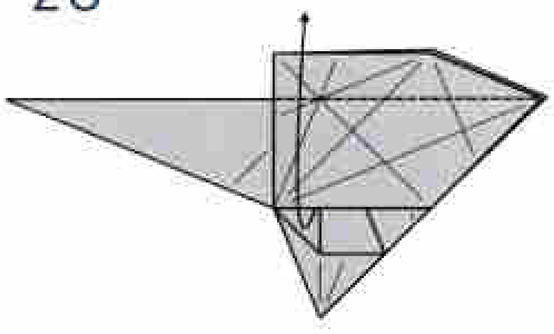
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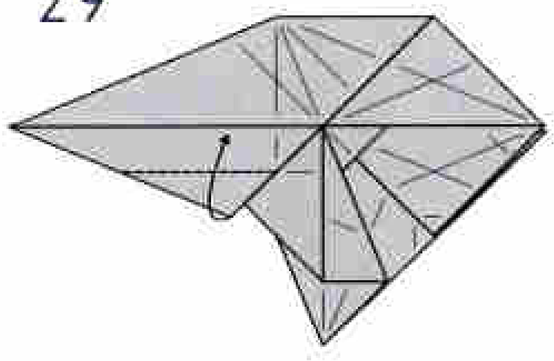
27



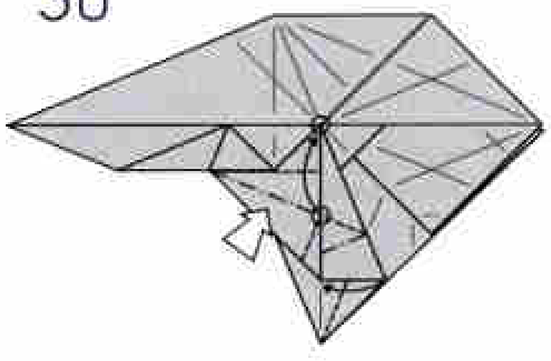
28



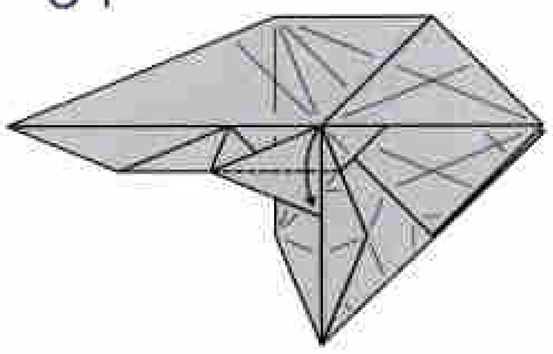
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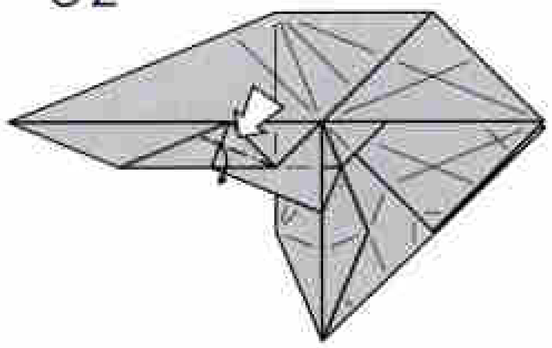
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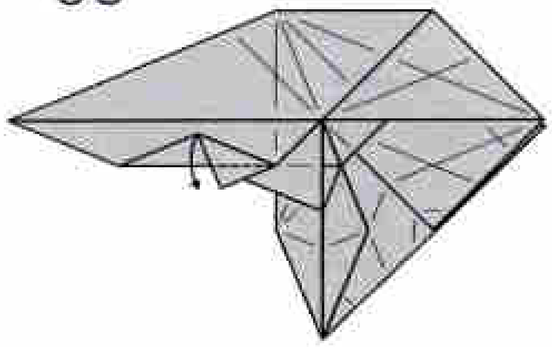
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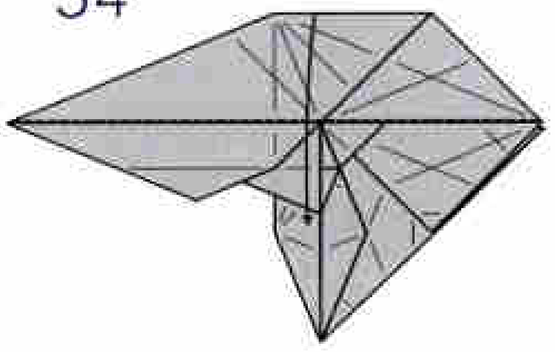
32



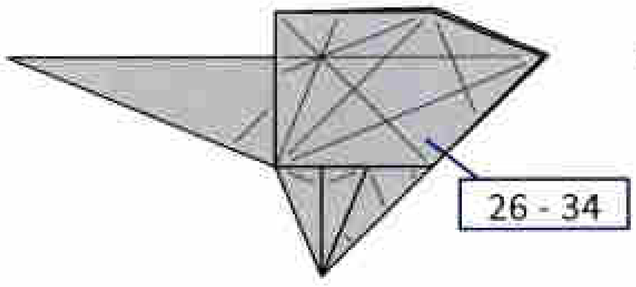
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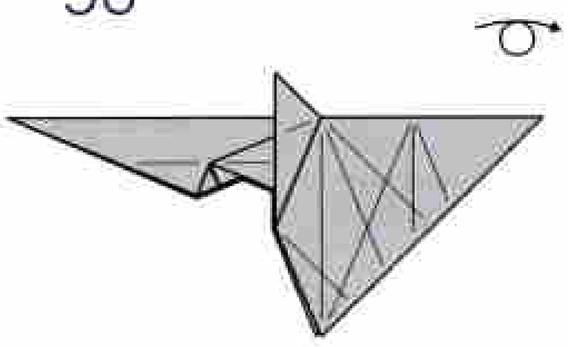
34



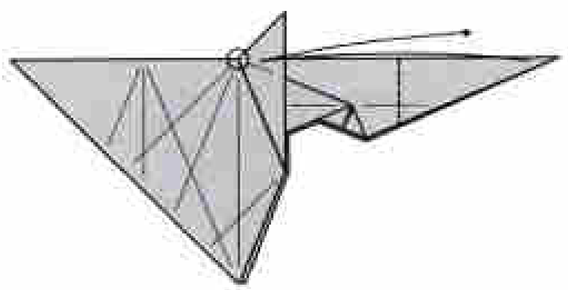
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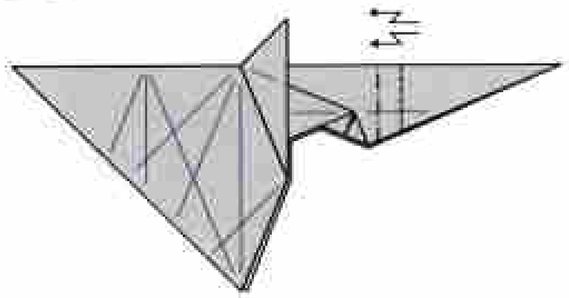
36



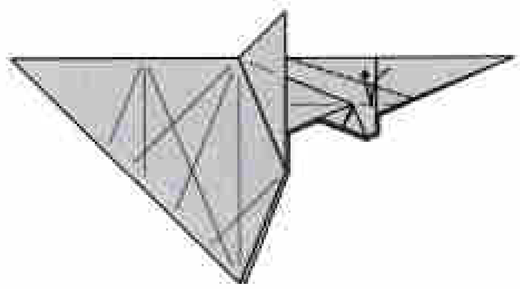
37



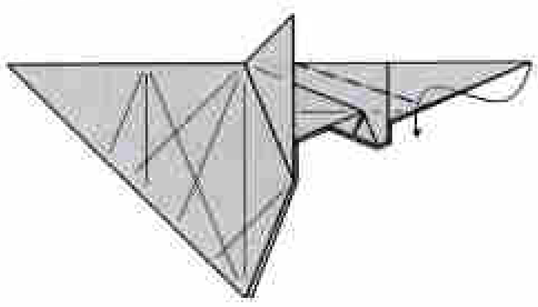
38



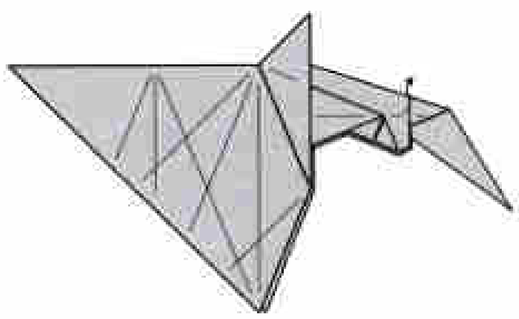
39



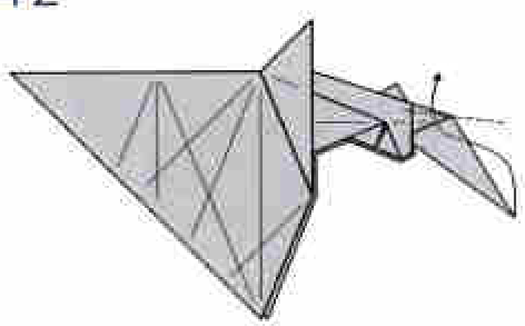
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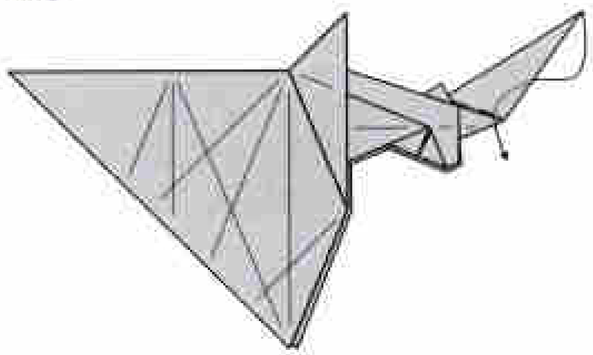
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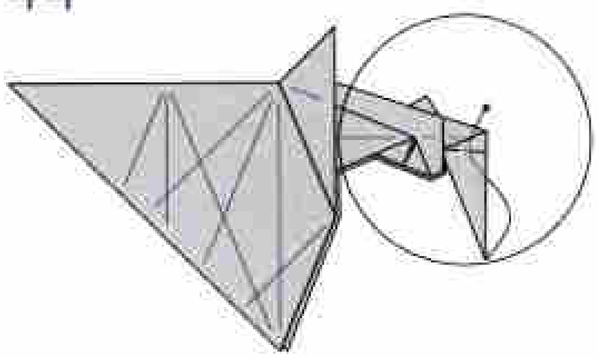
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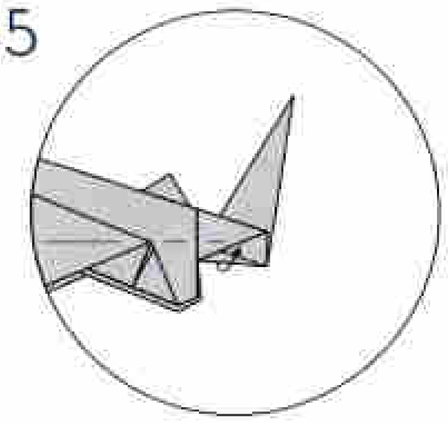
43



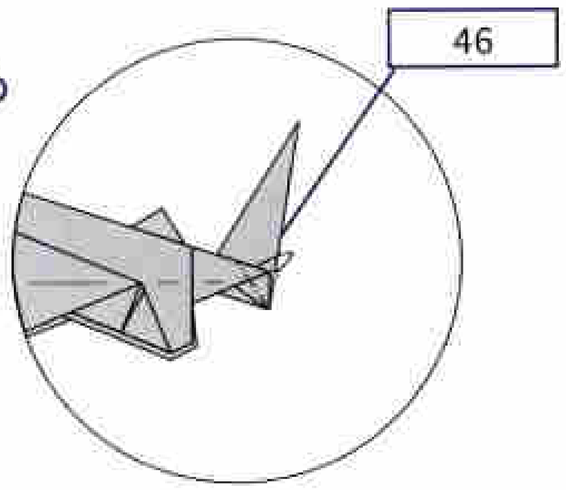
44



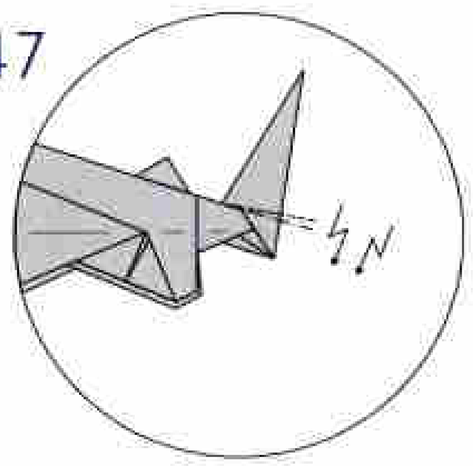
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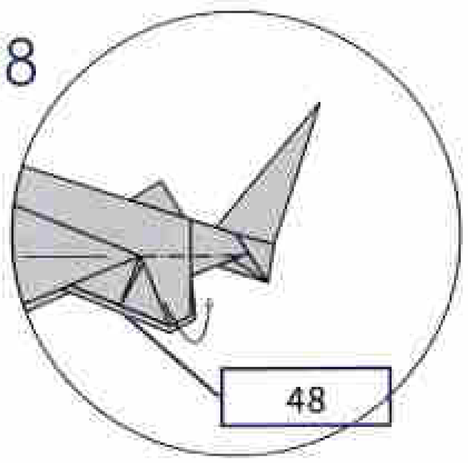
46



47



48



37
Fold and unfold. Use reference point.

38
Pleat inside.

41
Fold out the corner of the flap.

42
Inside reverse fold.

43
Inside reverse fold.

44
Inside reverse fold.

45
Valley fold.

46
Mountain fold. Repeat behind.

47
Crimp.

48
Mountain fold inside. Repeat behind.

49
Pull out paper only on one side.

50
Mountain fold.

51
Mountain fold. Repeat behind.

52
Fold and unfold. Repeat behind.

54
Mountain fold and unfold.

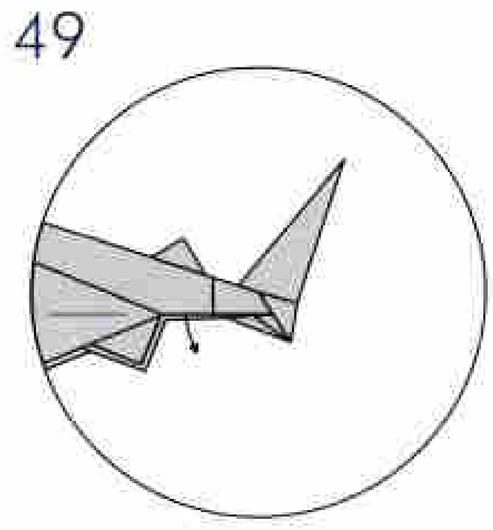
55
Pleat to the reference point. Repeat steps 54 and 55 behind.

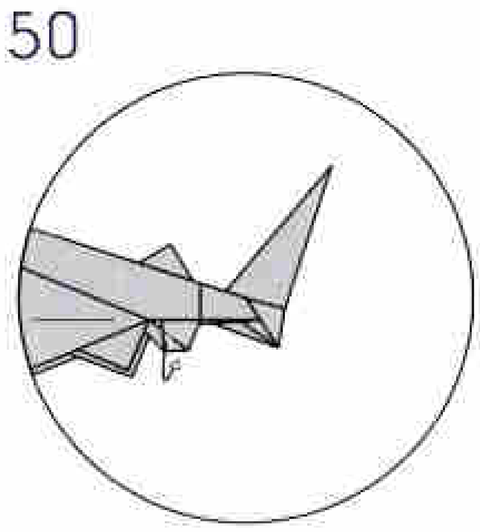
56
Inside reverse fold.

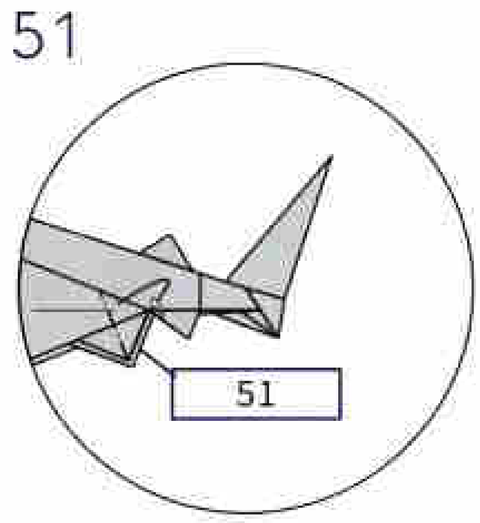
57
Inside reverse fold.

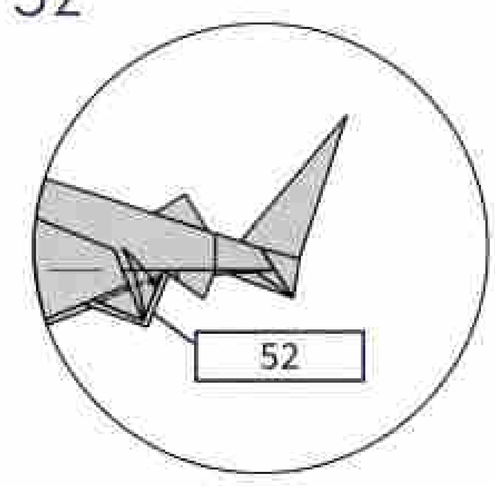
58
Repeat steps 56 to 57 behind.

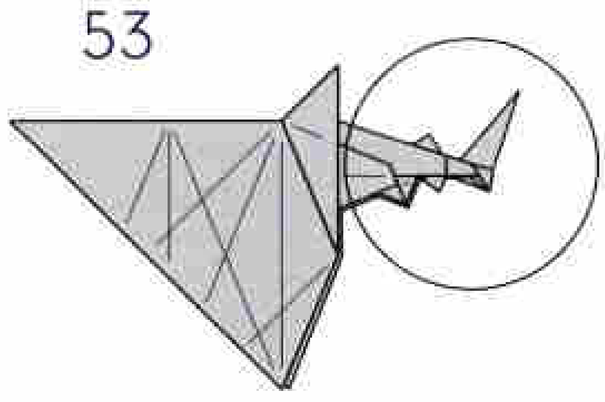
59
Crimp on both sides.

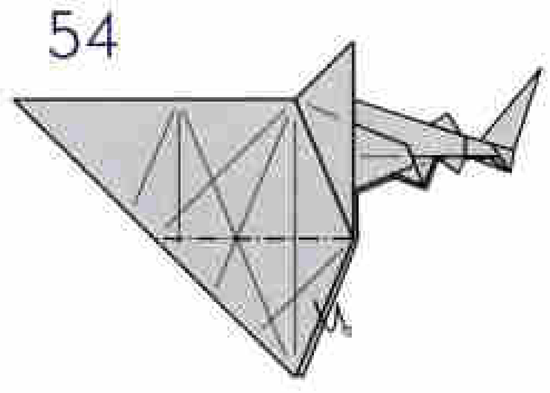


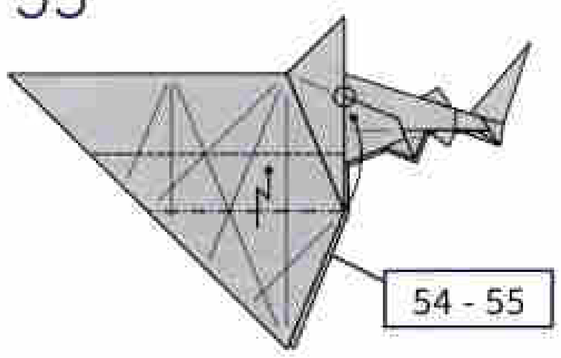


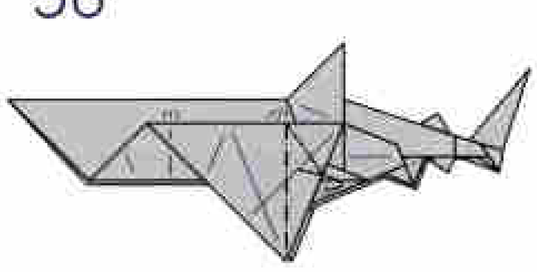


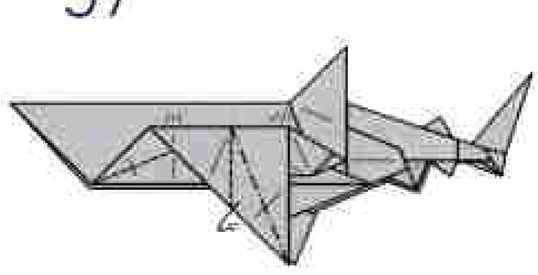


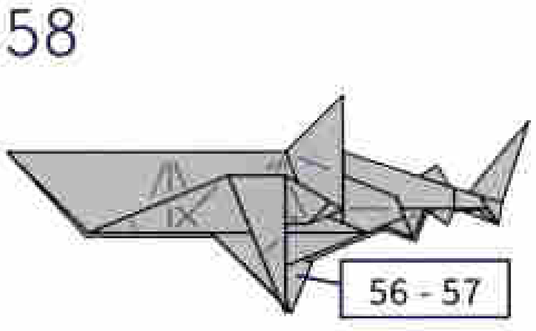


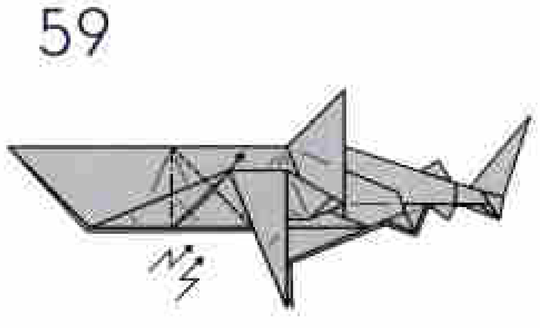


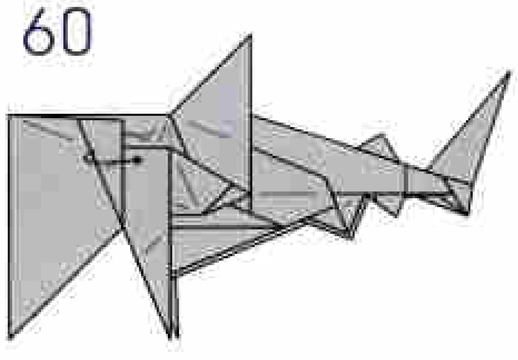




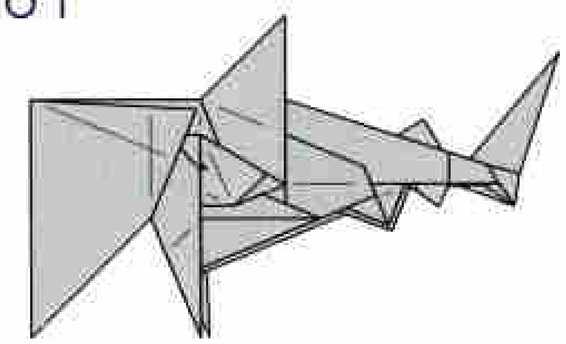




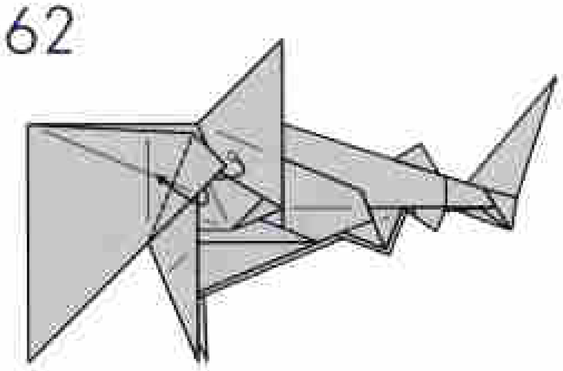




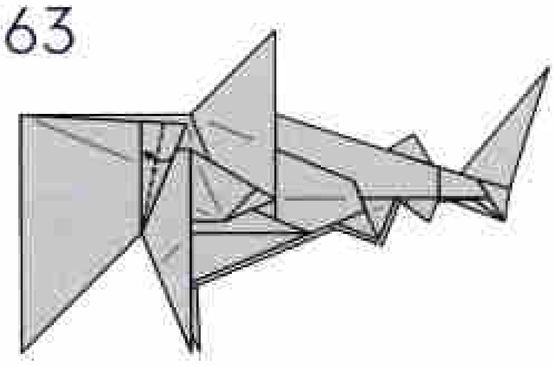
61



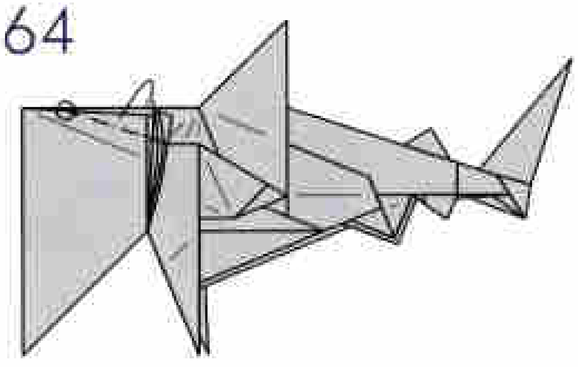
62



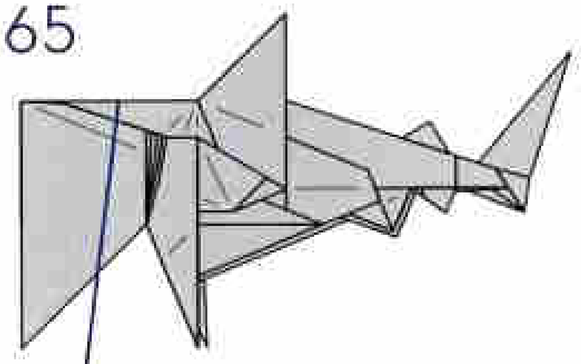
63



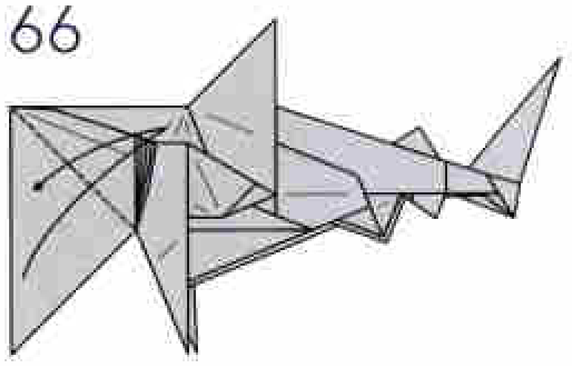
64



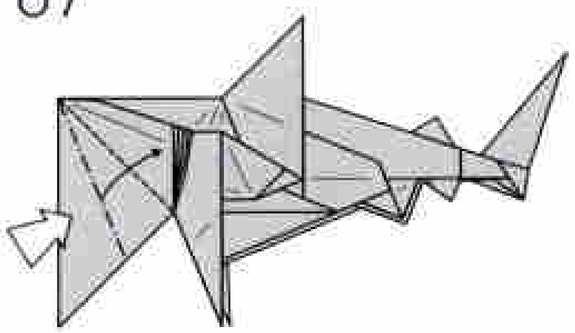
65



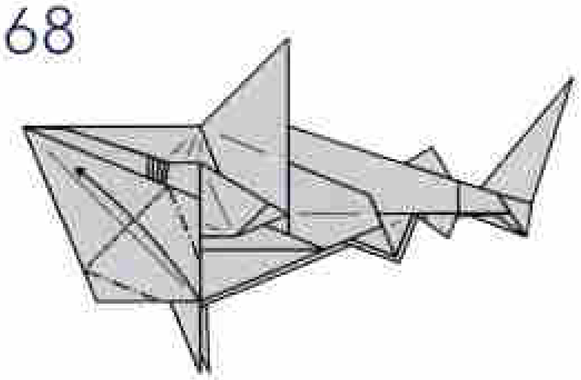
66



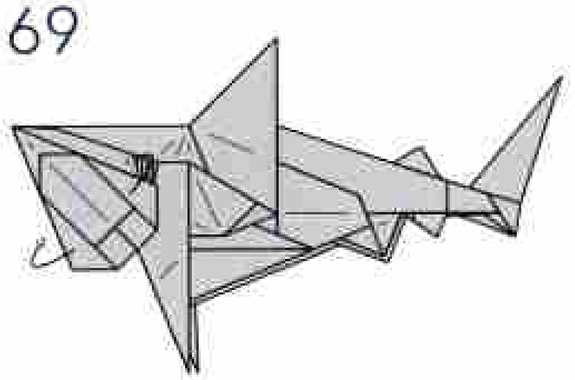
67



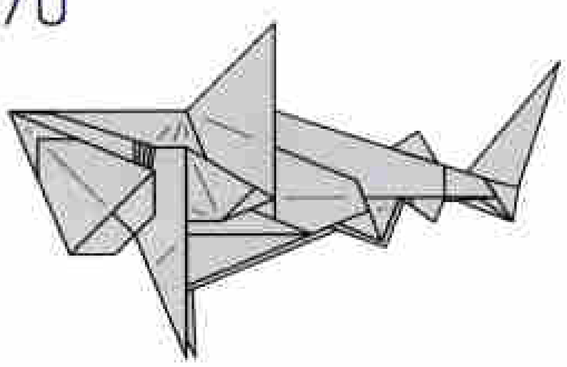
68



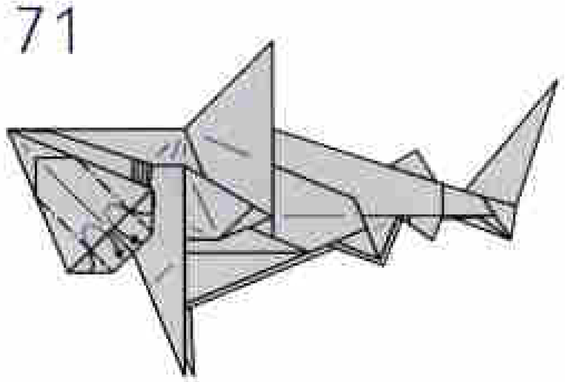
69



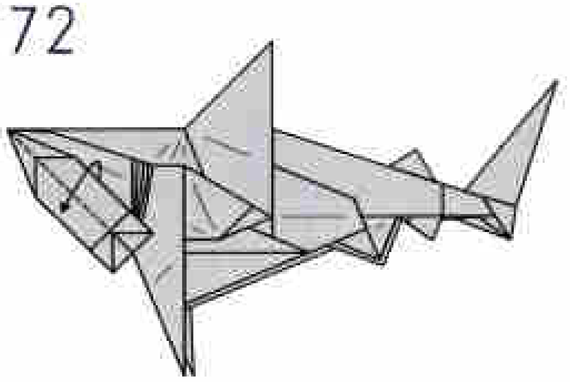
70



71



72



60
Unwrap the layer.

61
Pull out the paper.

62
Wrap the paper over.

63
Valley fold and spread layers.

64
Mountain fold. Crease does not reach corner.

65
Repeat steps 60 to 64 behind.

68
Petal fold.

69
Wrap the paper around.

71
Inside reverse folds.

73
Crimp.

74
Crimp.

75
Fold the fin up at an angle. Repeat behind.

76
Fold and unfold.

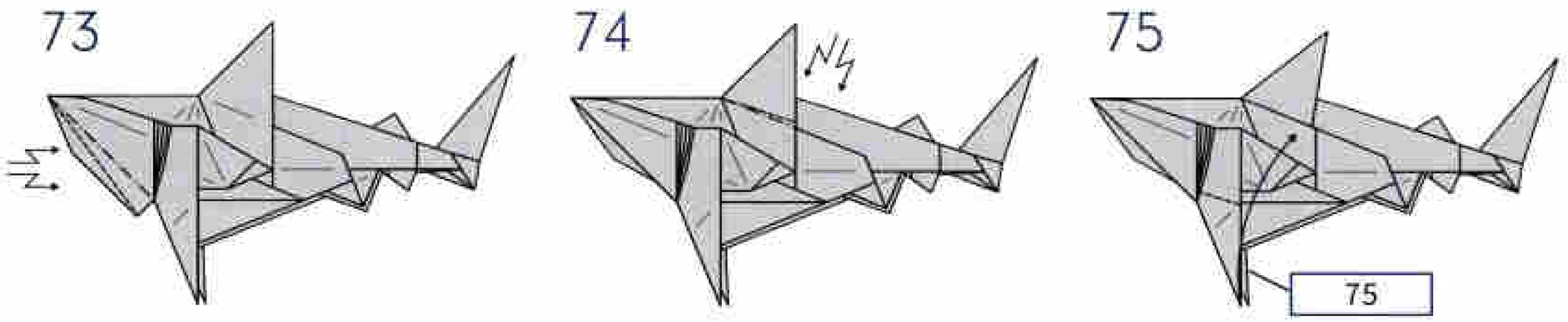
77
Inside reverse fold.

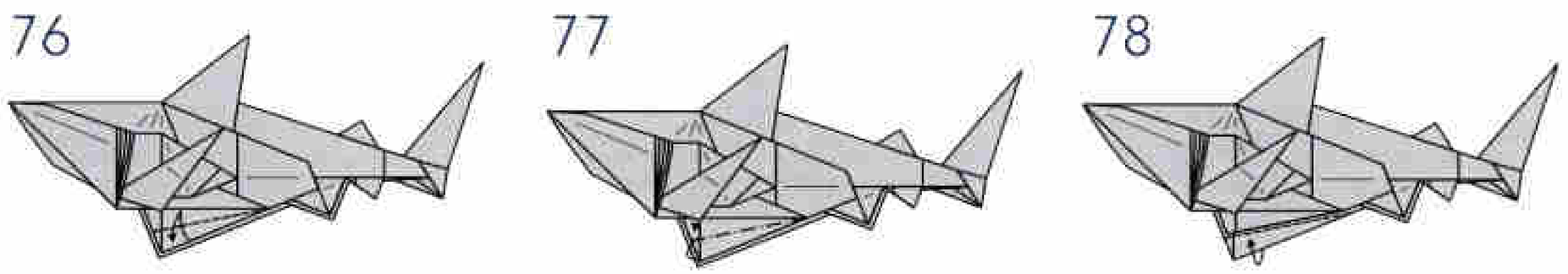
78
Valley fold the flap inside.

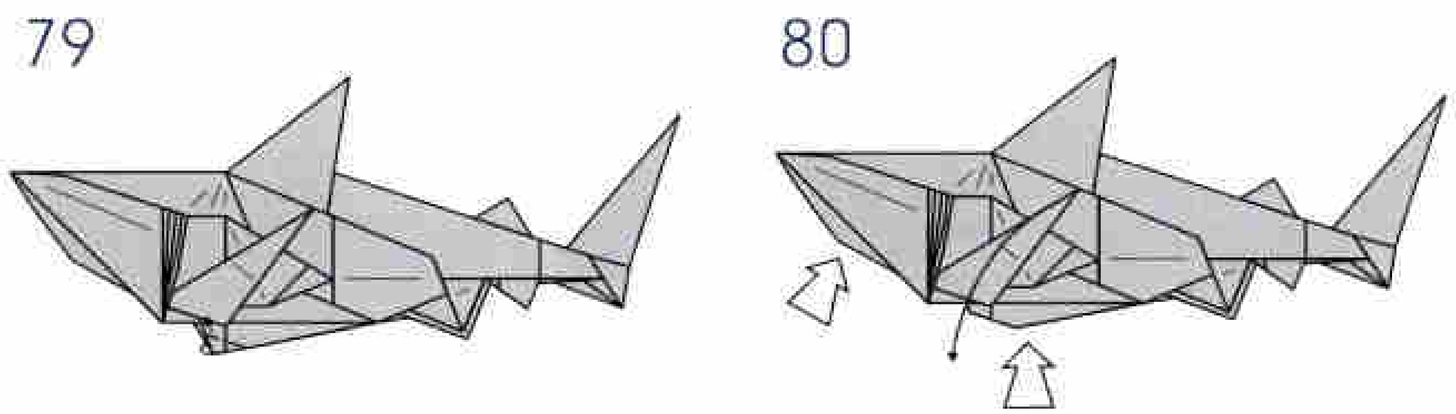
79
Inside reverse fold.

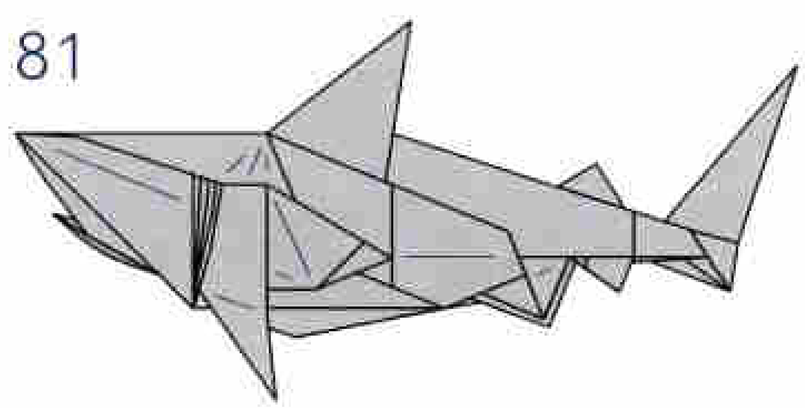
80
Shape.

81
Bull shark completed.









Fish

Flounder

Simple Fish

Fish

Angelfish

Butterflyfish

Boxfish

Horse Mackerel

Sea Horse

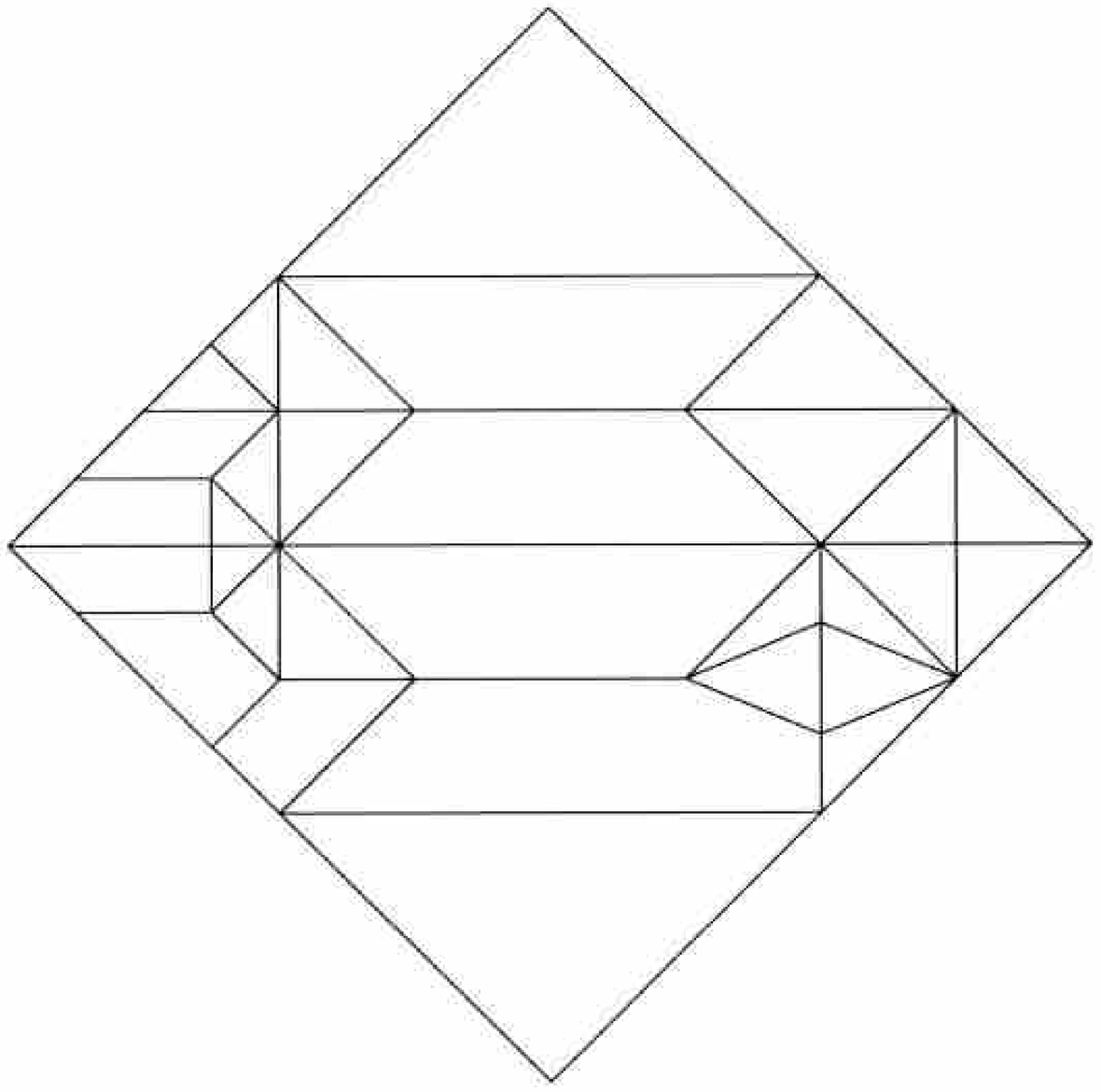
Tuna

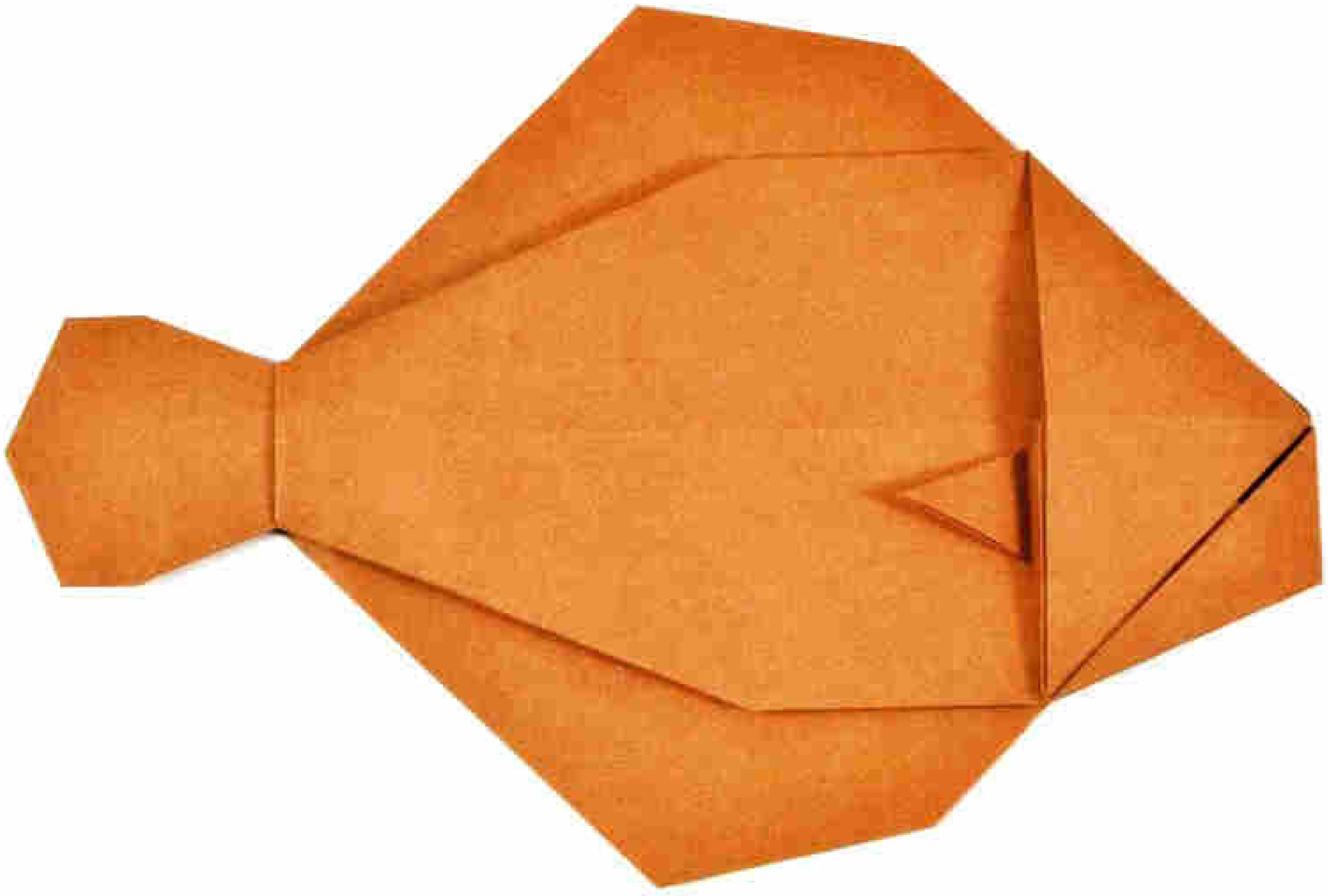
Giant Sea Bass

Flounder

Flatfish commonly lie resting or hidden on the sandy bottoms near reef formations. There are a number of local species; one of the most well known is the California halibut, also known as the California flounder.

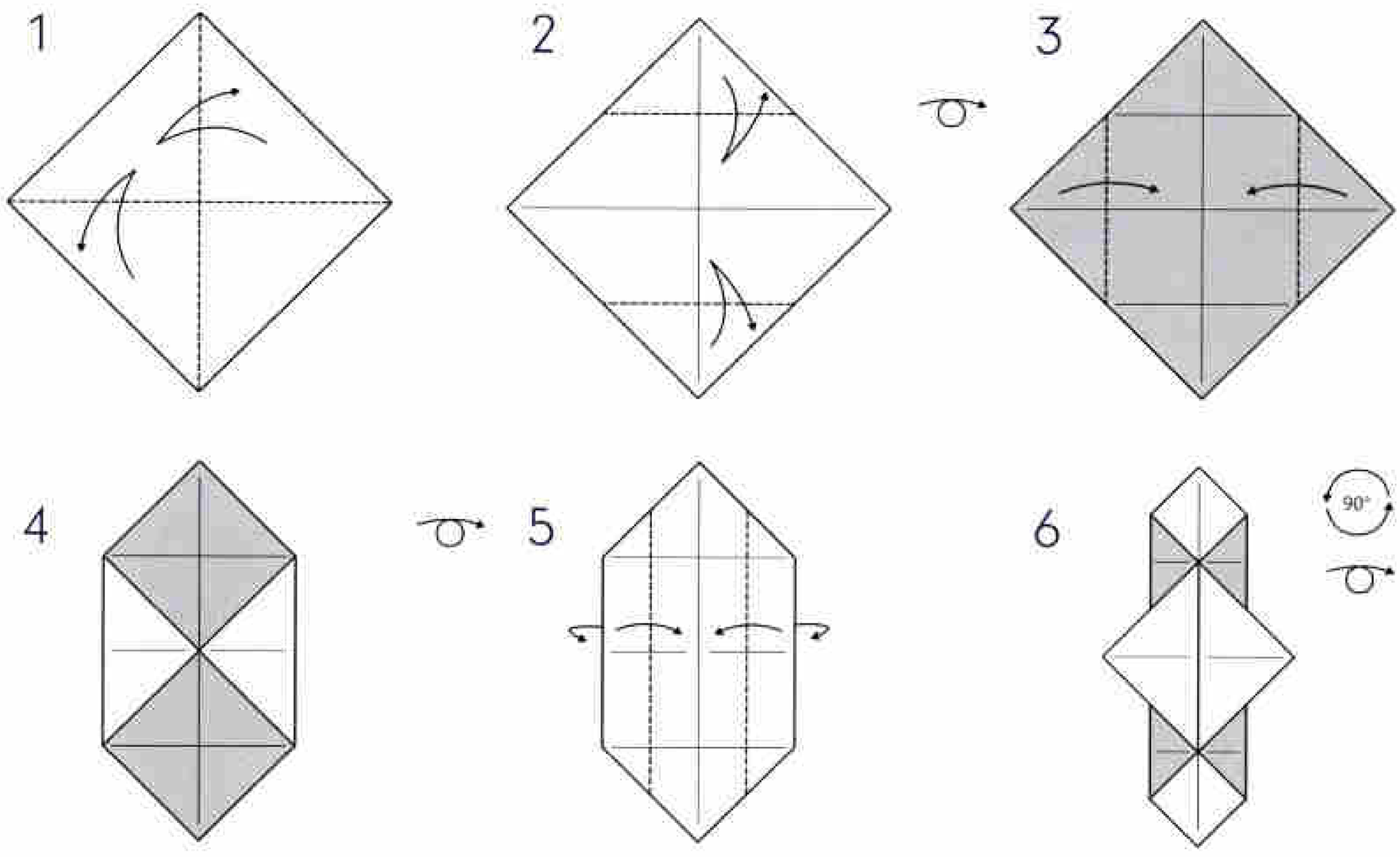
This design was the result of free-folding with a small three-by-three inch sheet of paper. I started with symmetric pleats down the center of the paper, which distributed paper for the head and tail structures. The anatomy of this particular model turned out surprisingly accurate, given the simplicity of the initial folds. The head contains some unique folds that lock the jaw and face. I purposely left out details in the head area to produce a simple abstract appearance.

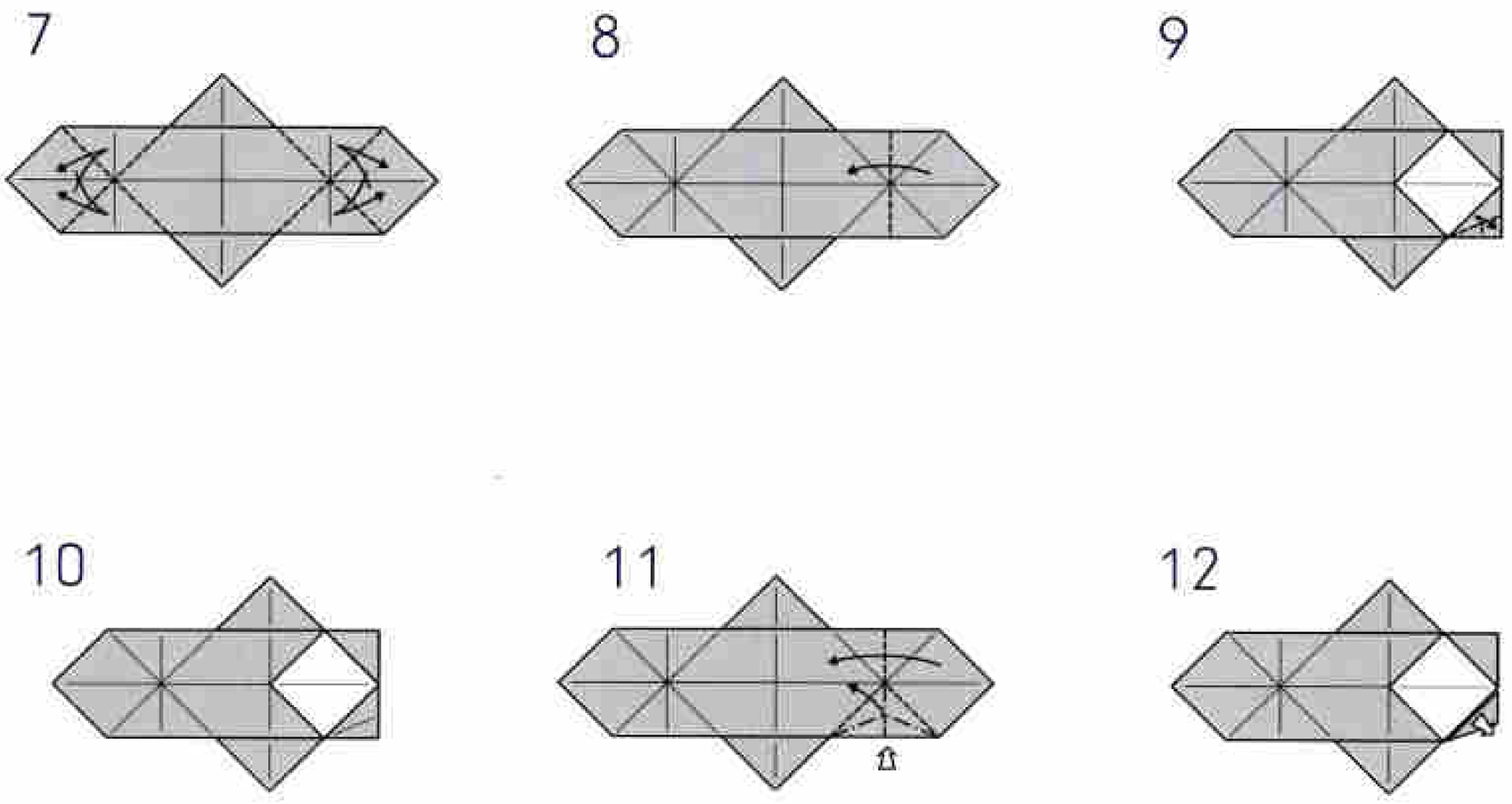




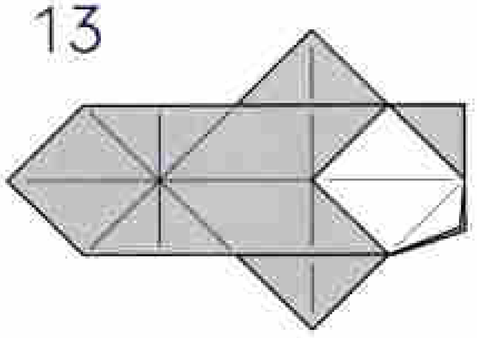
11
Valley fold like in step 8, but include squash at the arrow.

12
Unsink flap.

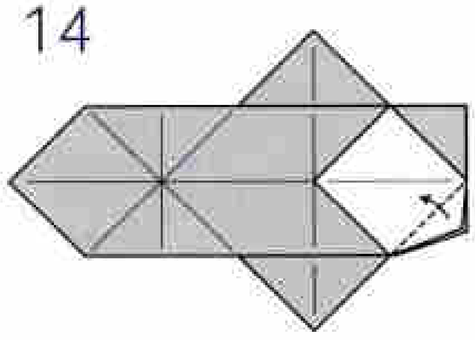




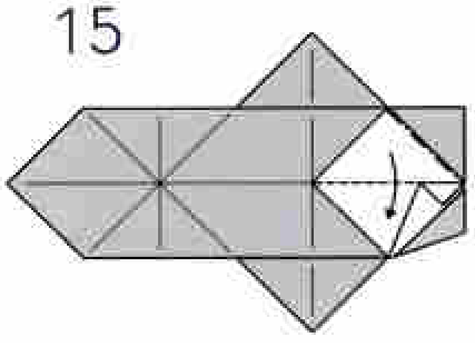
13



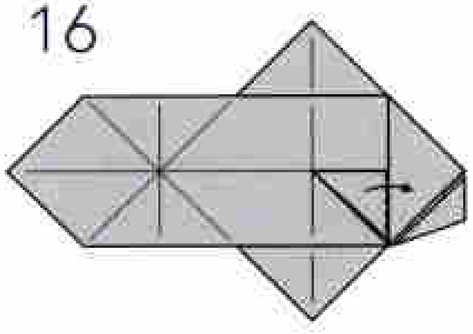
14



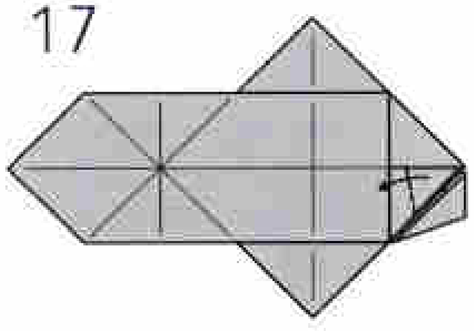
15



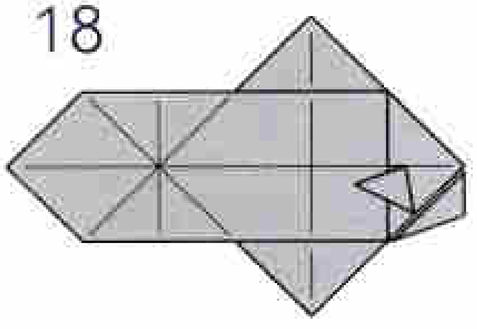
16



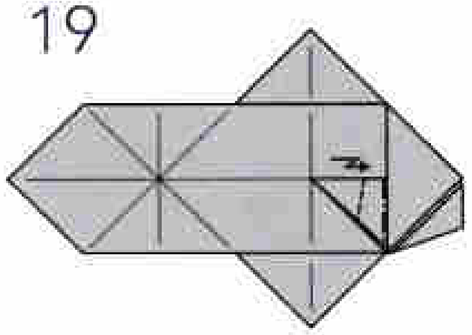
17



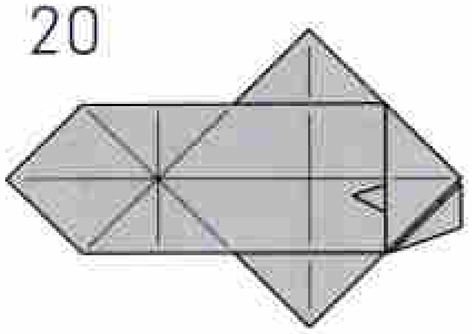
18



19

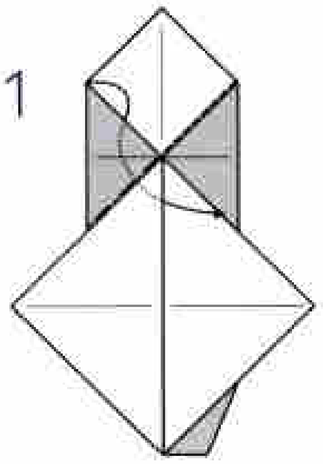


20

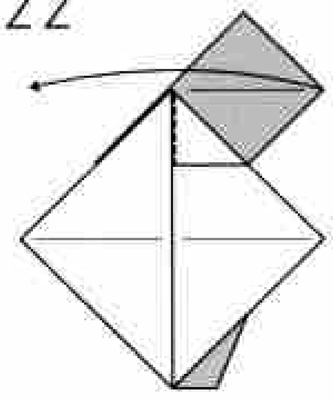




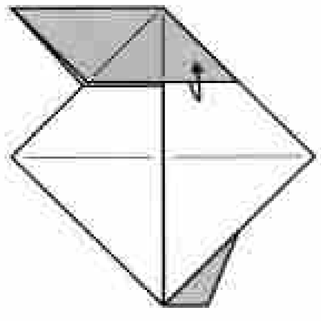
21



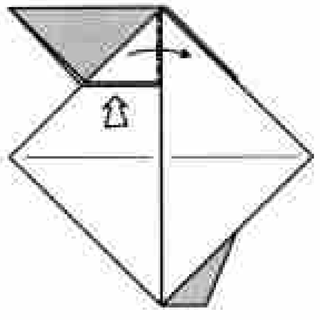
22



23



24



18
Unfold to step 16.

21
Inside reverse fold.

23
Pull out flap and bring over.

24
Squash.

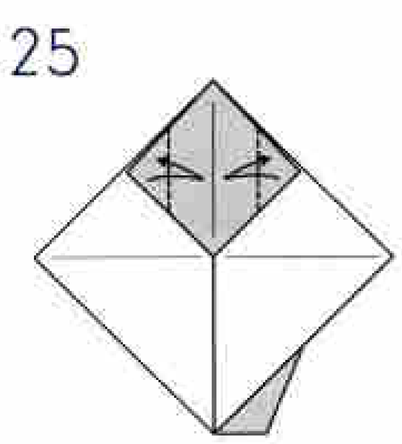
27
Bring corners of the large body flaps over the tail flaps.

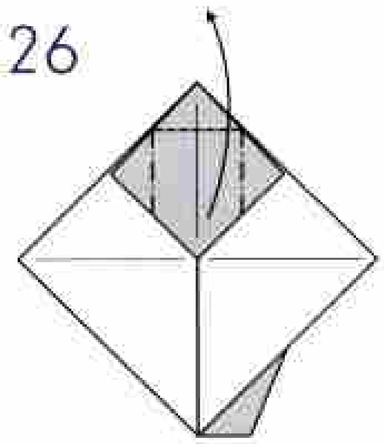
29
Angle bisector.

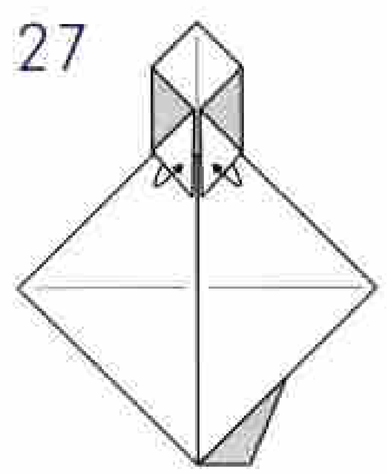
31
Repeat steps 28 to 30 on the left side.

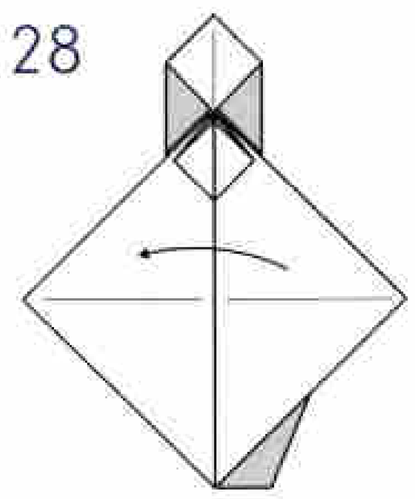
32
Tuck left flap under left side.

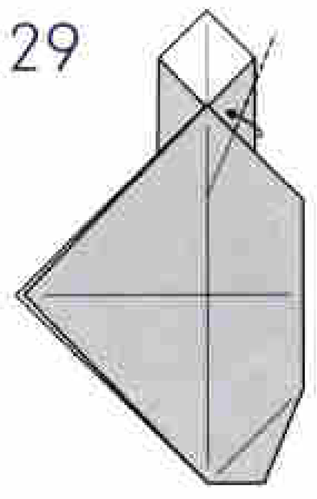
33
Tuck right flap under left side.

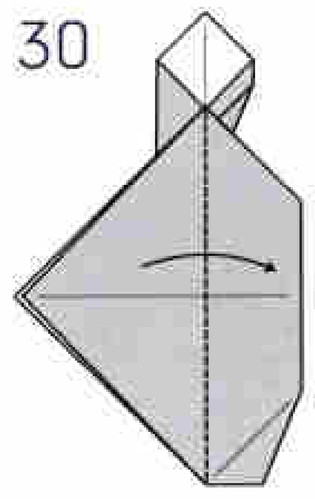


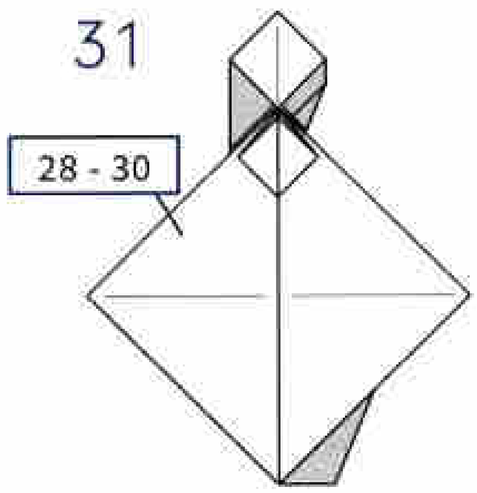


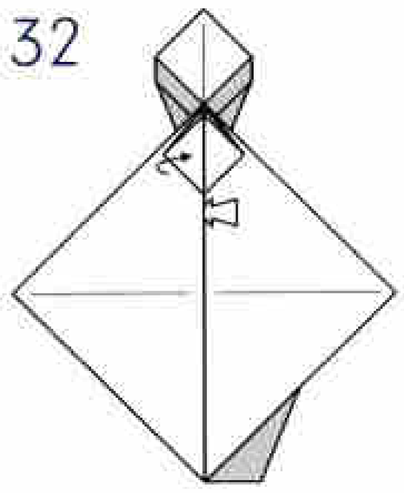


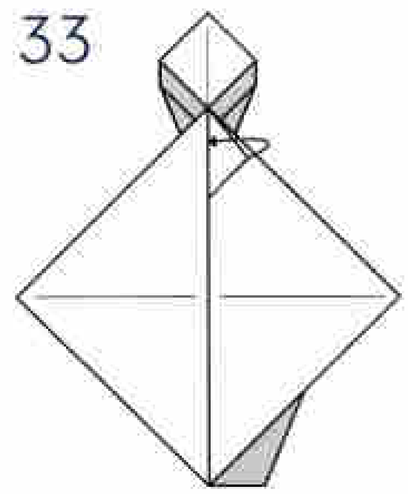


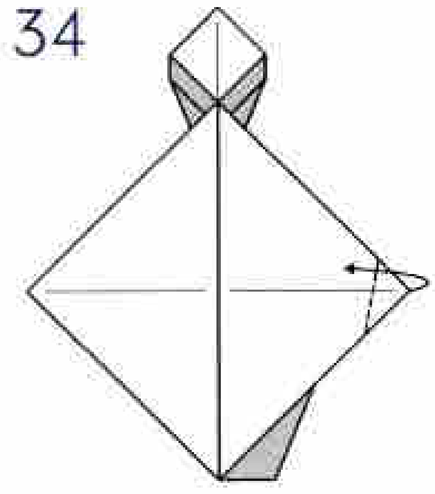


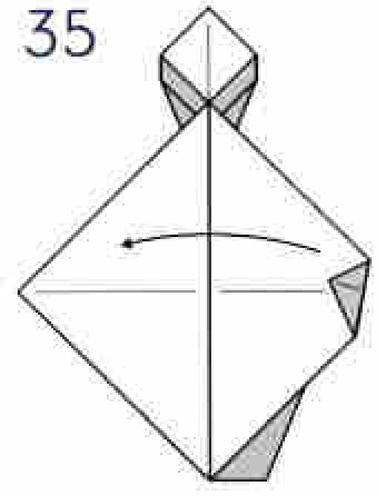


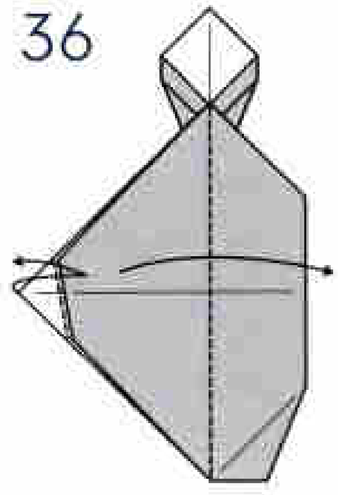








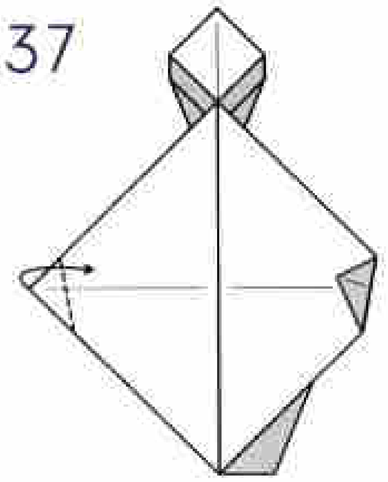




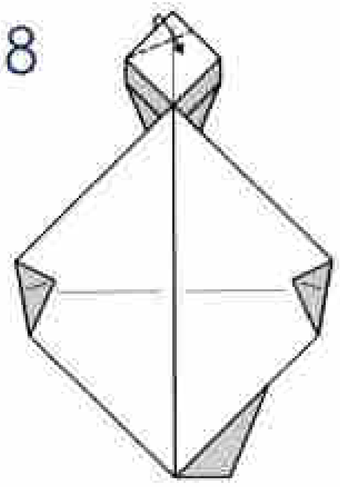
42
Unfold part of the tail to do the mountain fold.

45
Flounder completed.

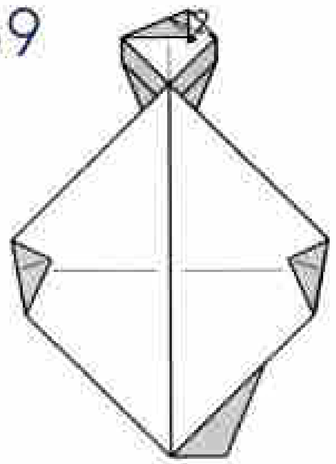
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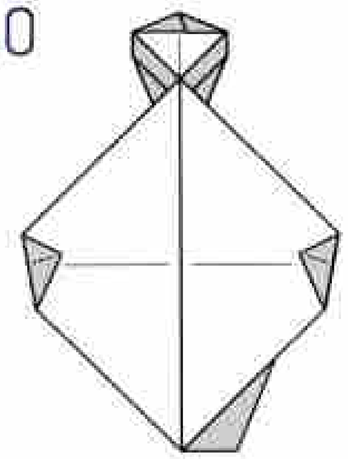
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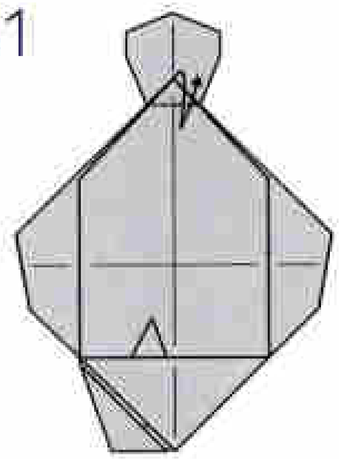
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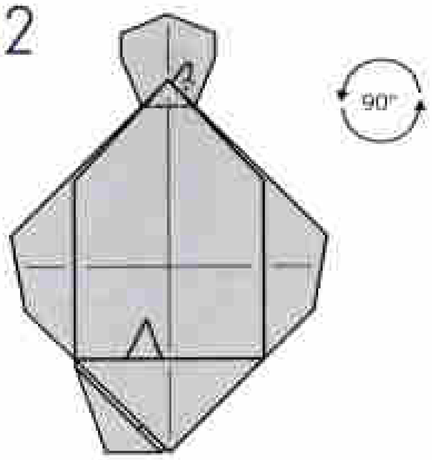
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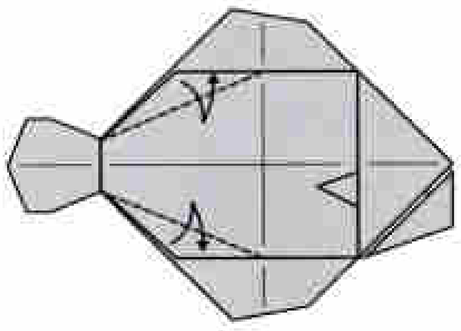
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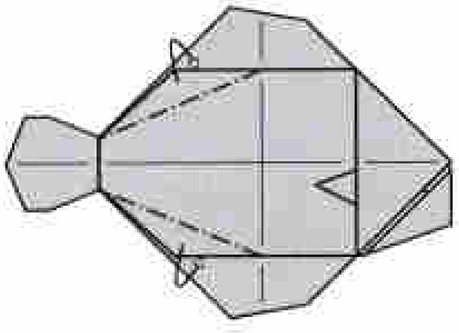
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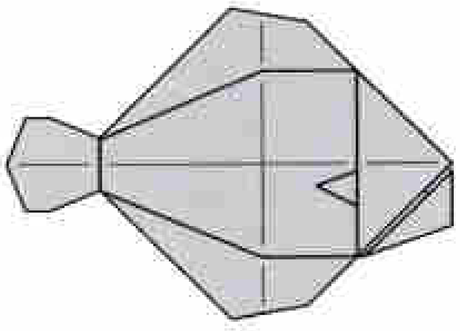
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44

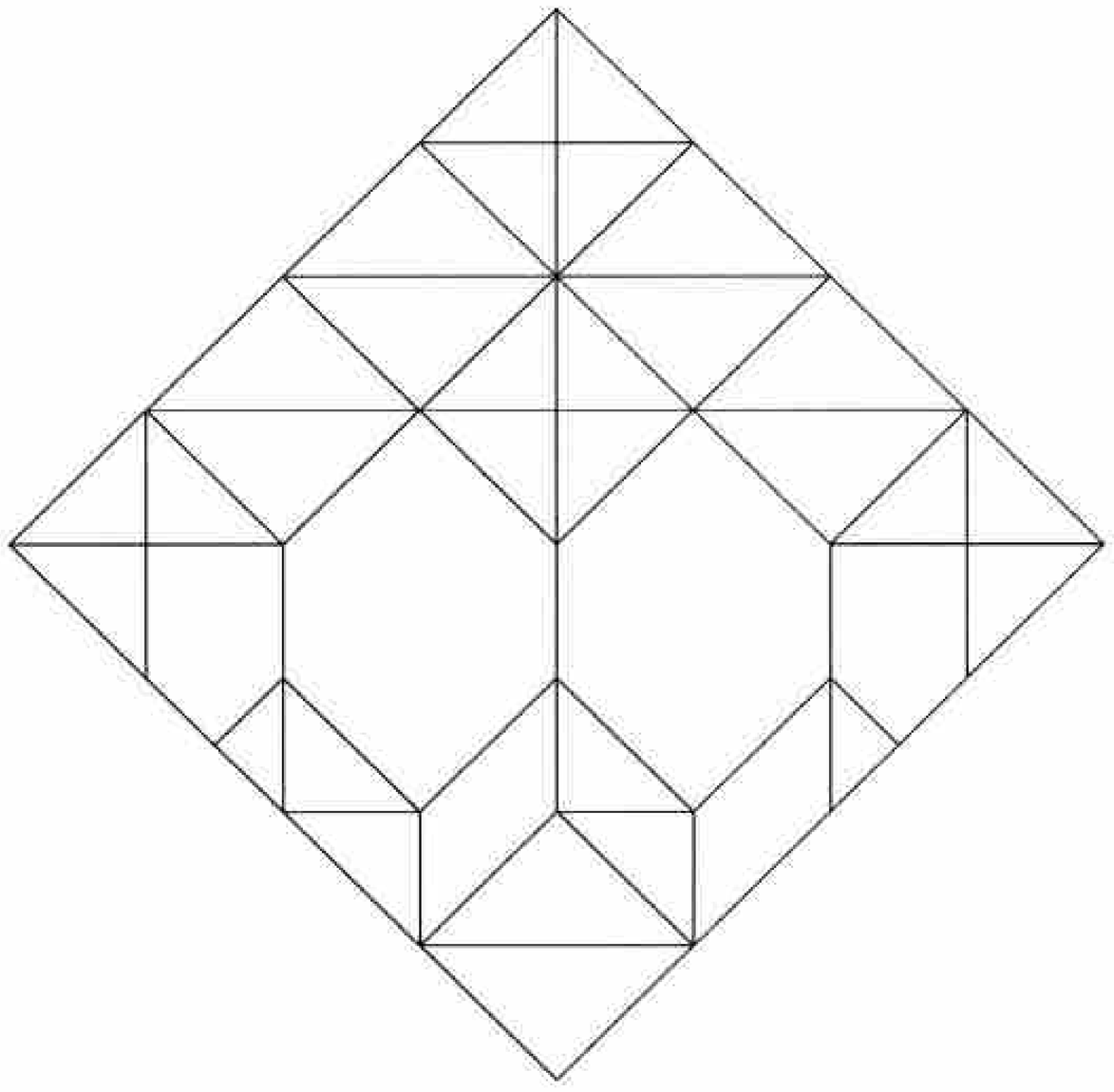


45



Simple Fish

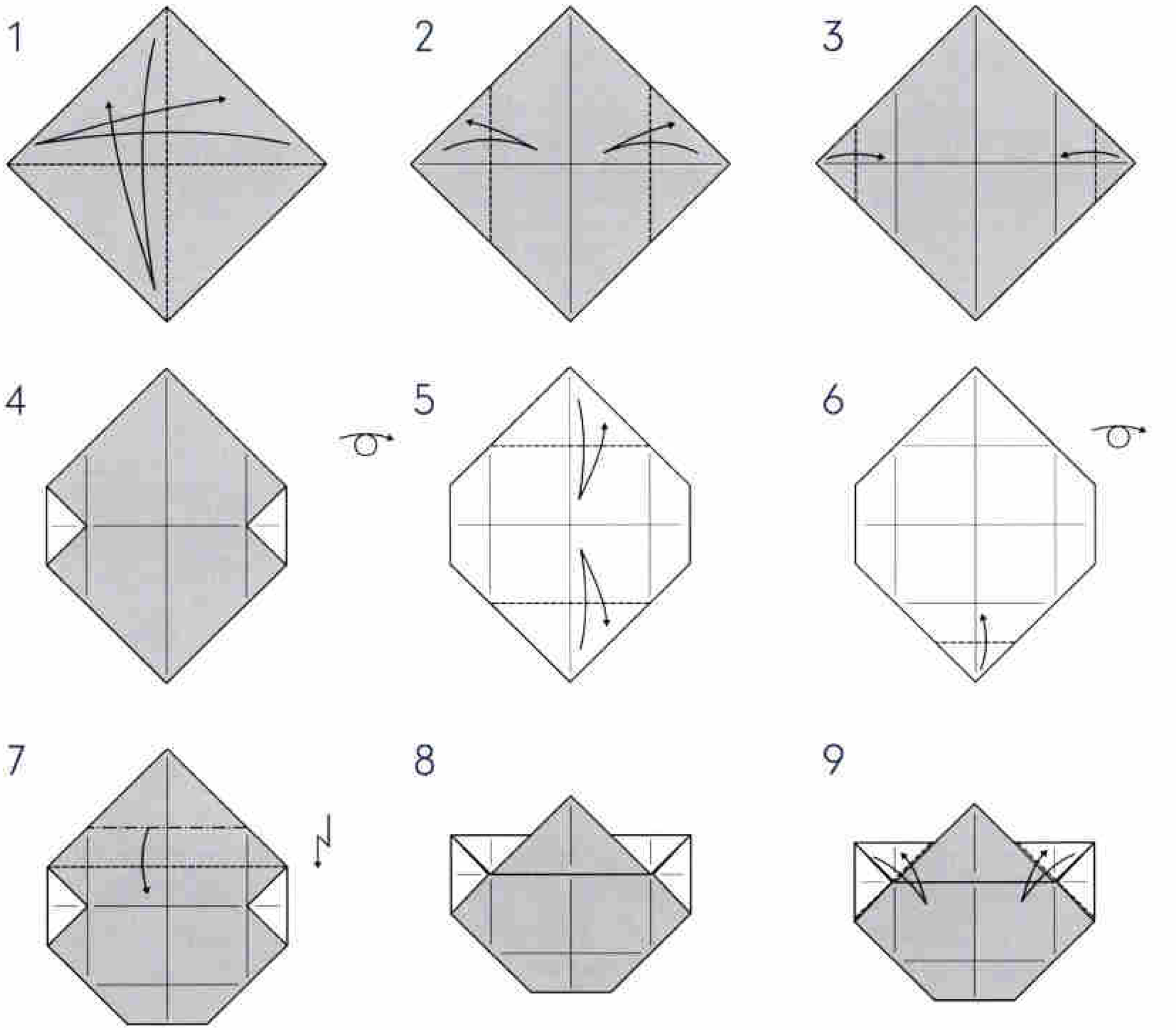
The simplest design in this series, the simple fish, is based on an eight-by-eight grid. The folding procedure is fairly straightforward—a series of basic folds, reverse folds and squashes. The benefit of designing models like this is that you can treat them as foundational structures for more detailed designs such as those with scales. The ratios can be altered to lengthen the fish.



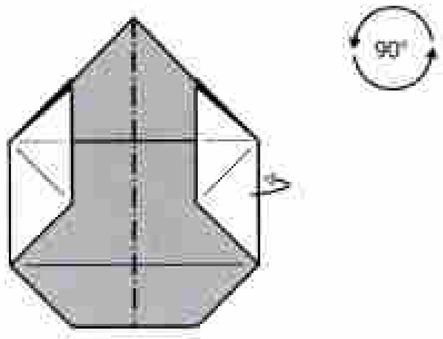


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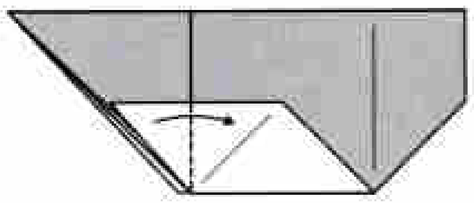
Inside reverse fold.



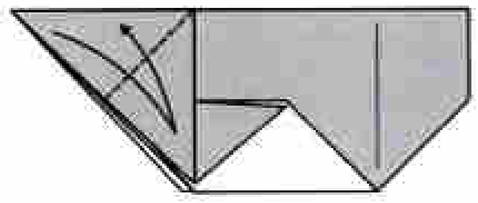
13



14



15



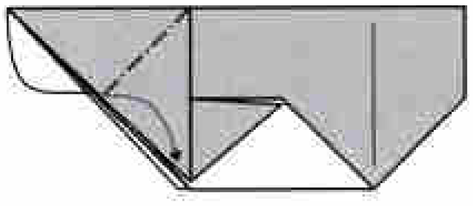
16

Inside reverse fold.

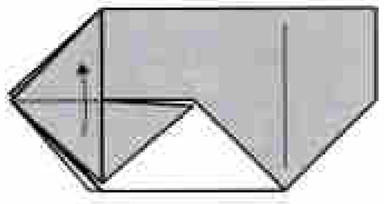
17

Valley fold inner flap to lock.

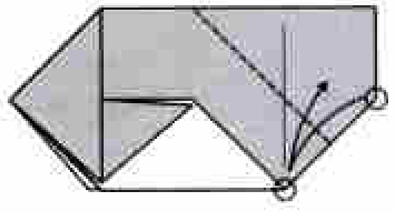
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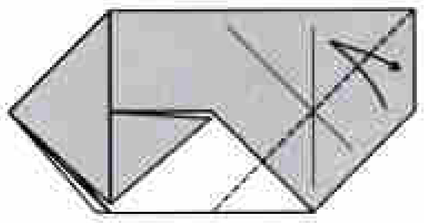
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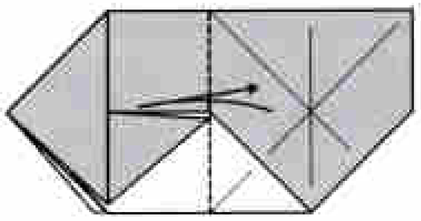
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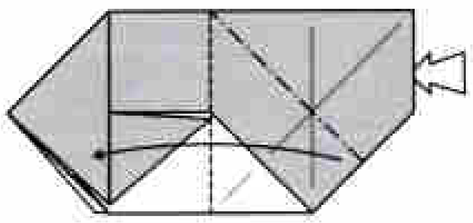
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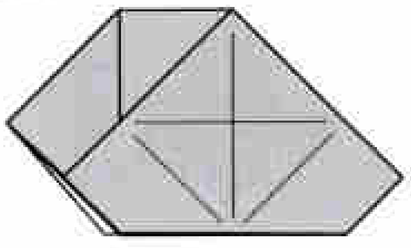
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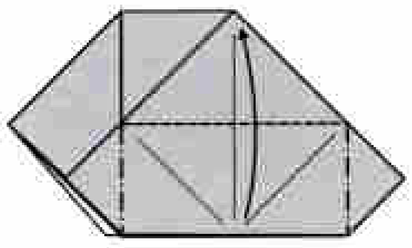
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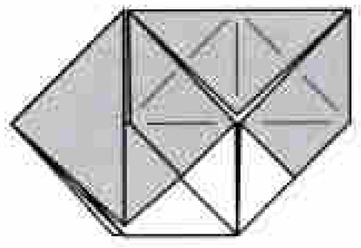
22



23



24

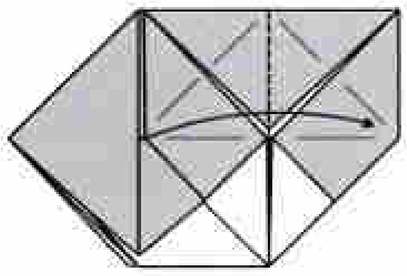


26
Inside reverse fold.

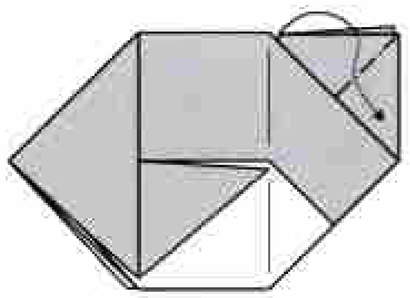
27
Reverse fold.

28
Simple fish completed.

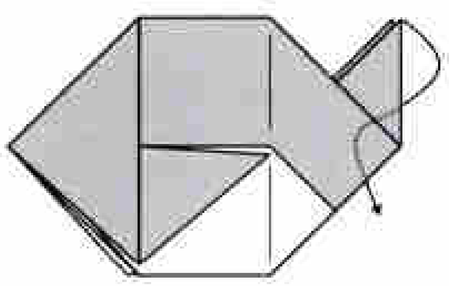
25



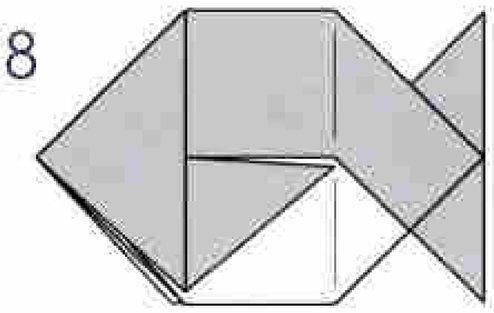
26



27



28



On Precision

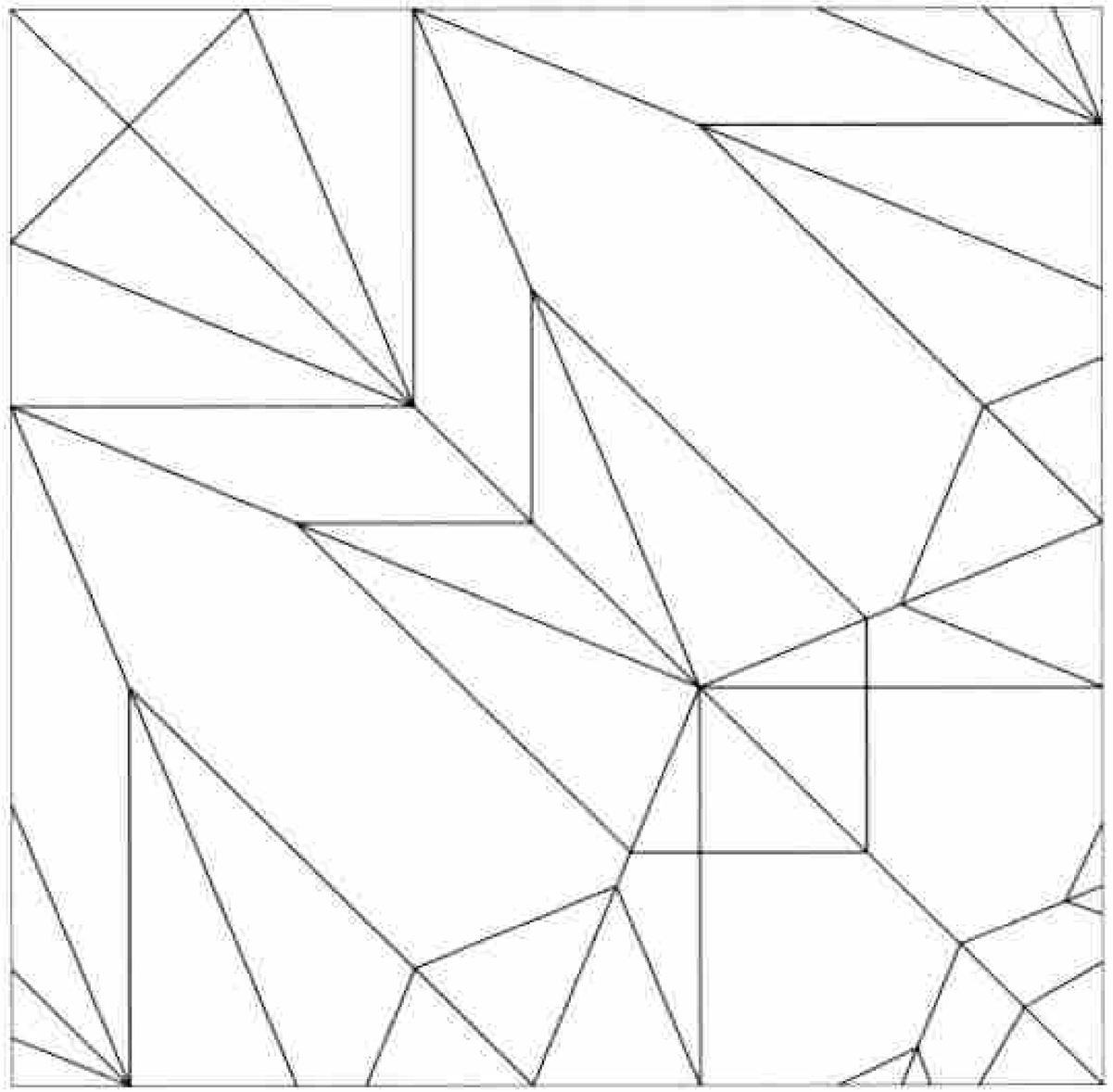
In order to fold a model accurately, you will need to be precise in your folds. Precision begins when you cut the paper into a square. Make it as exact as possible—almost all folds rely on previous references. Continue the precision throughout all the folding stages, even if it requires more folding time. Keep an eye on corners and hidden layers in case they collapse.

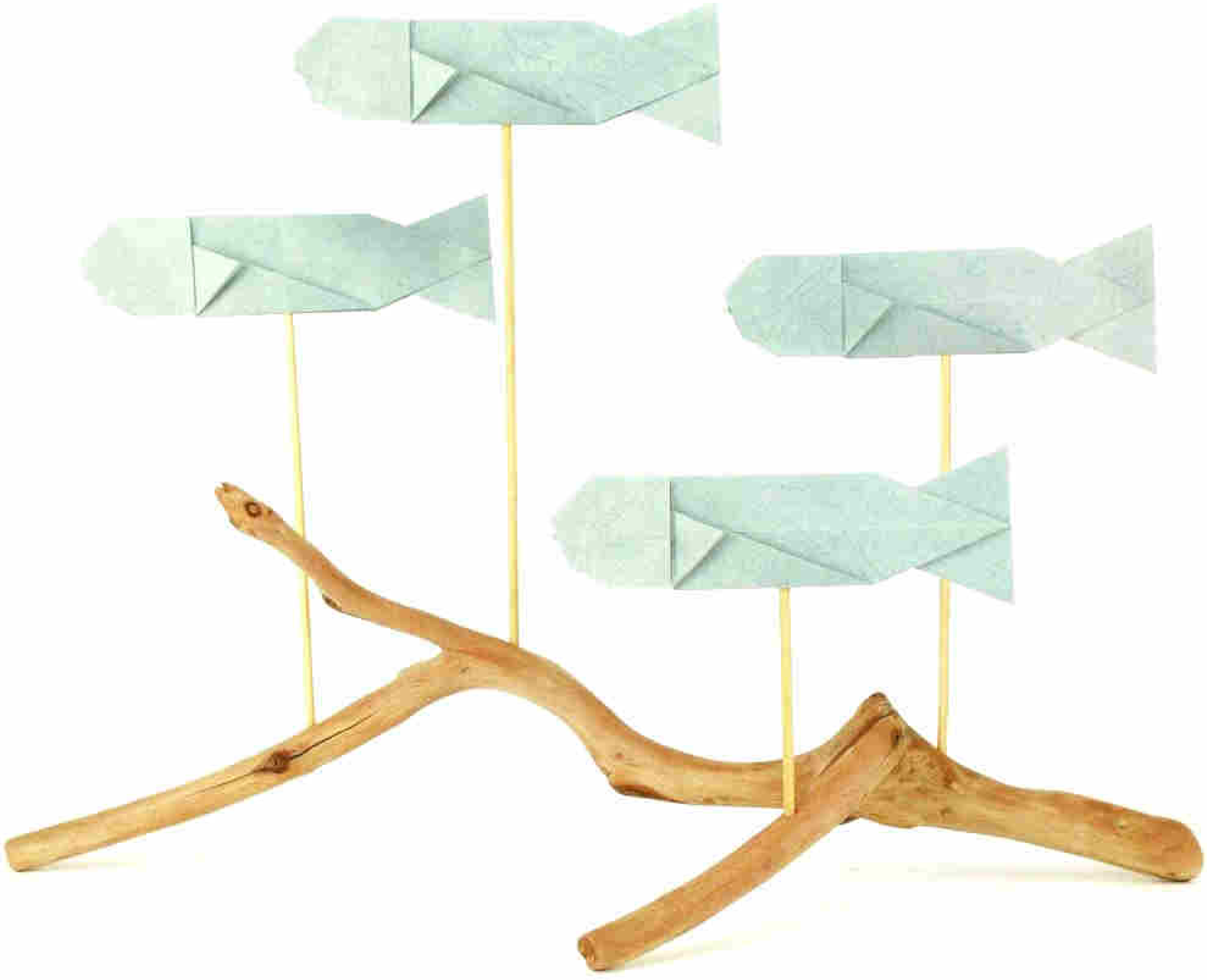
Precision is the result of technique, that is, understanding how best to execute each fold with your hands. The basic method for a valley fold is to first bend the paper in the desired direction without creasing. Use your hands to fine-tune the paper to the reference. After you make your micro-adjustments, hold the paper in place and perform the crease, making sure there is no slack. Every type of fold requires specific techniques to do them accurately and efficiently.

Consistently making precise folds requires concentration and practice. Fold your creases on a flat surface, instead of folding it in the air. Focus on making your creases neatly, and over time it will become second nature.

Fish

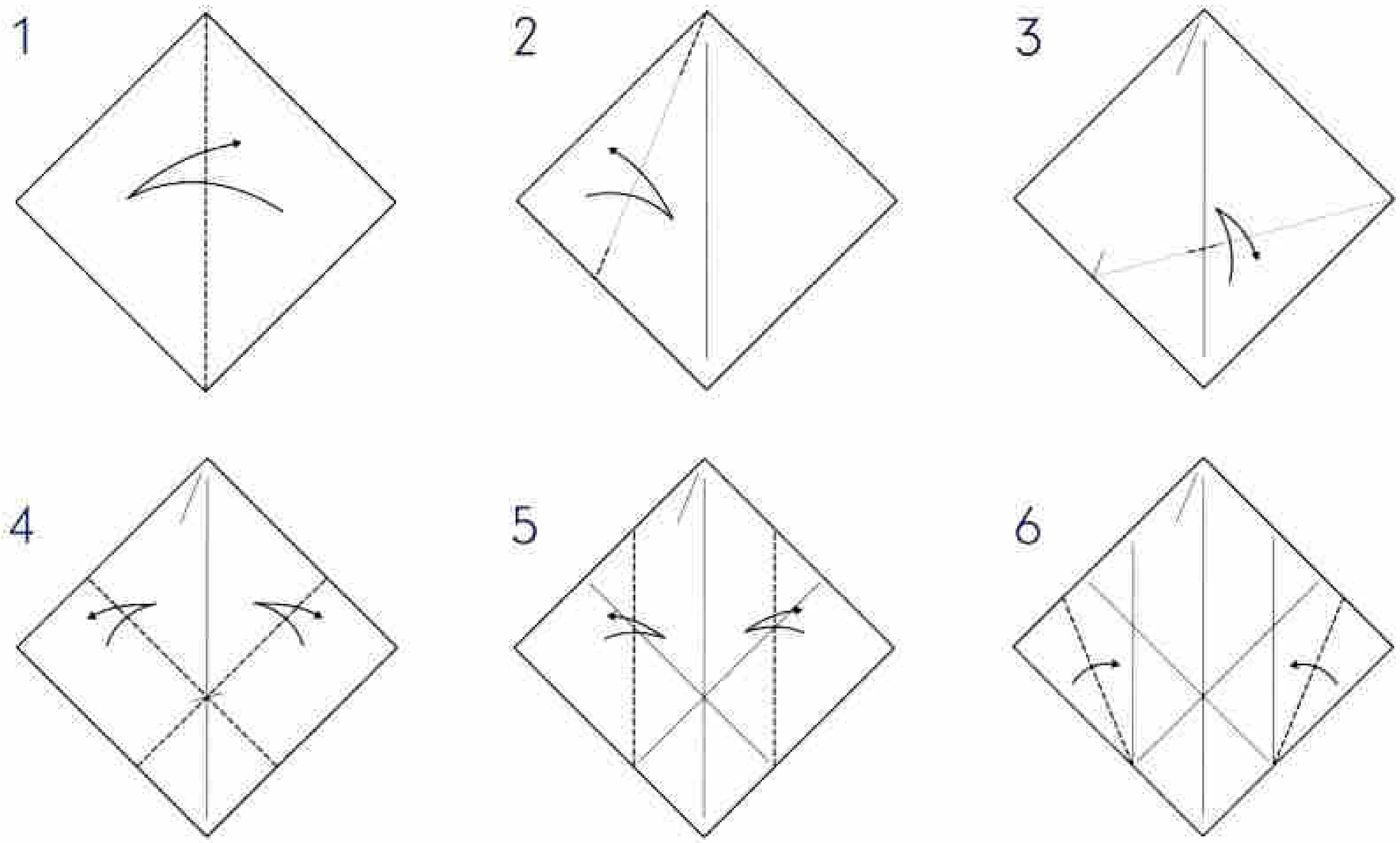
Diving from the shore, I often encounter schools of small fish: mackerel, top smelt, grunion. This model is inspired by those schools of fish, and it is also one of my first fish designs. A key component in its structural design is the head collapse that allows the lower corners to be reverse folded into pectoral fins. When designing this model, I focused on the tail first, since it is usually the body part which is most difficult to design in a fish model.



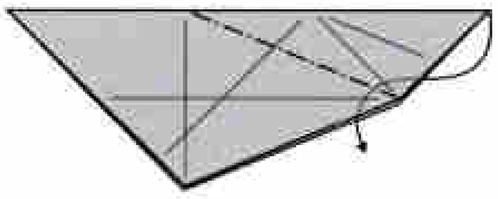


9
Crimp.

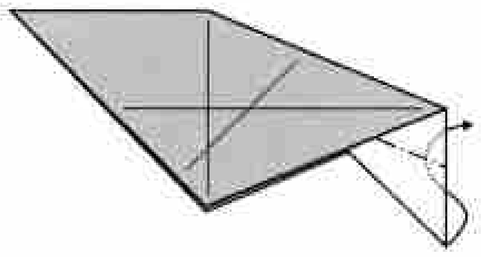
11
Unfold to step 9.



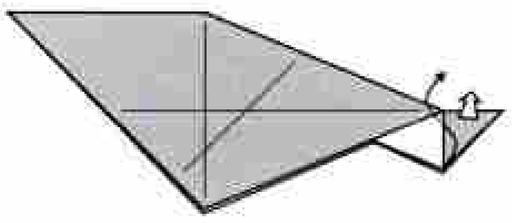
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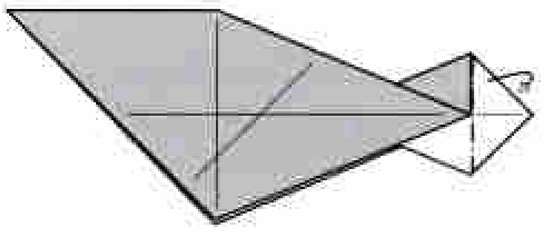
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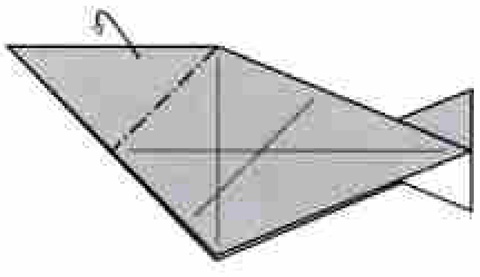
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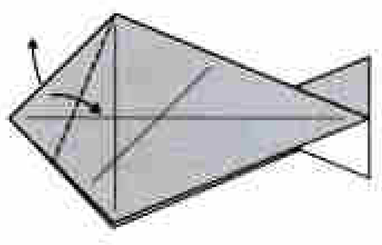
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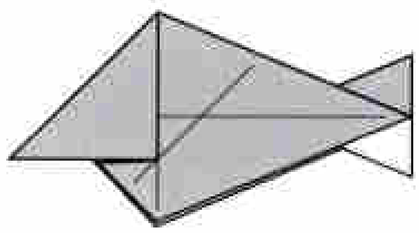
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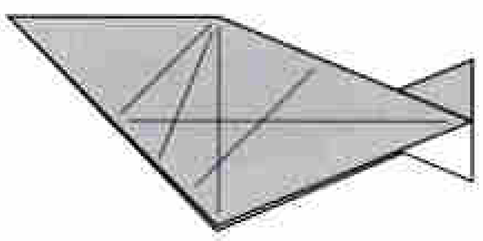
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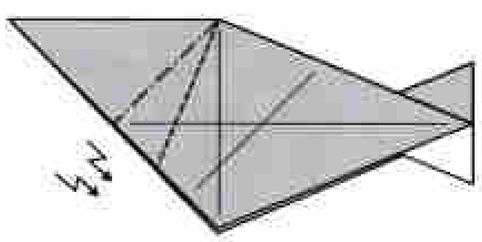
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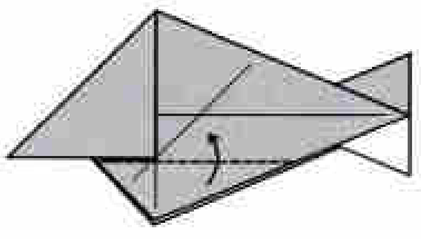
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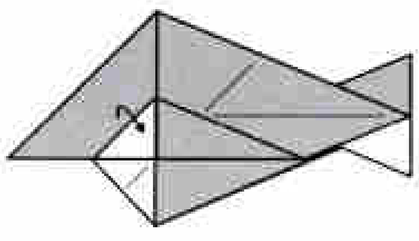
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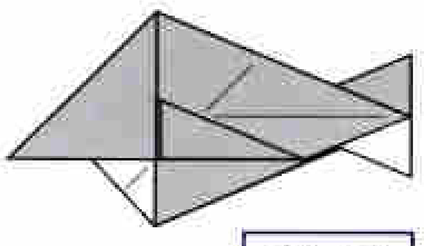
22



23



24



16
Tuck behind.

19
Unfold crimp.

23
Tuck under.

24
Repeat steps 22 and 23 behind.

25
Mountain fold to reference point.

27
Closed sink.

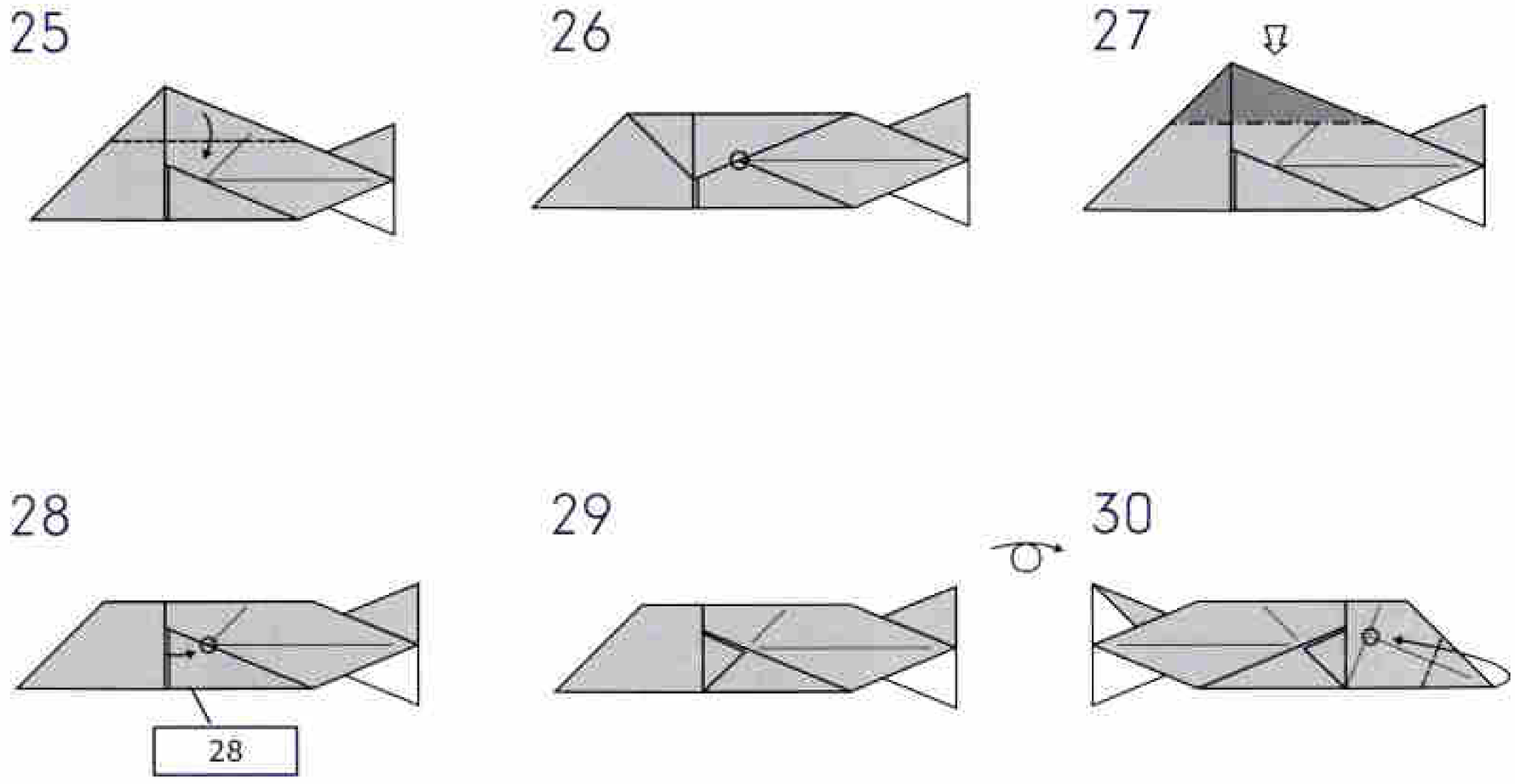
28
Pull out the fin to the reference point. Repeat behind.

32
Unfold to step 30.

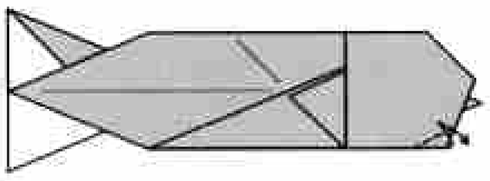
33
Crimp inside.

35
Underside view of the head.

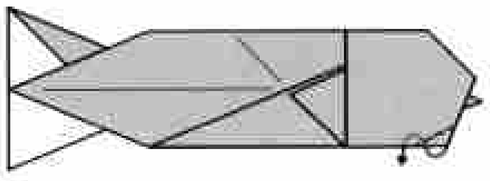
36
Tuck right flap behind left flap. Close model.



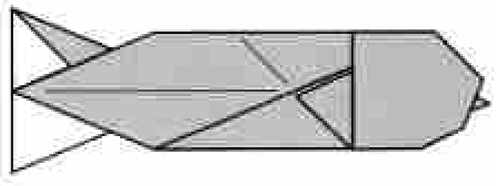
37



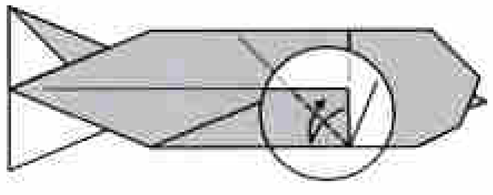
38



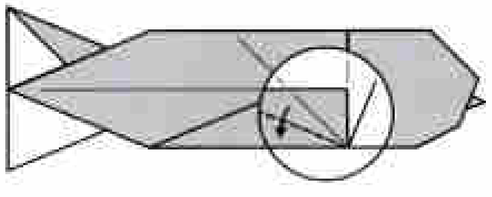
39



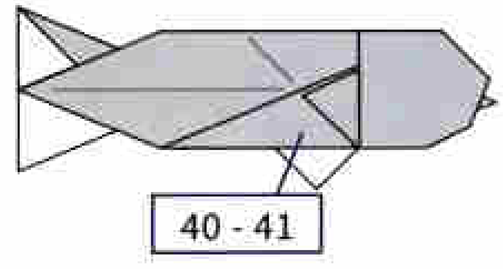
40



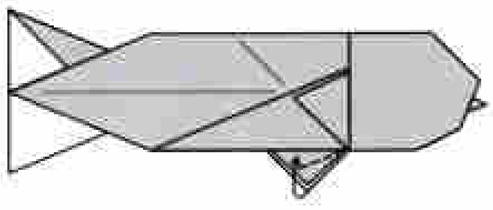
41



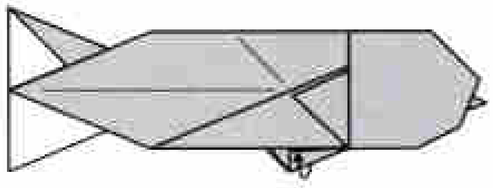
42



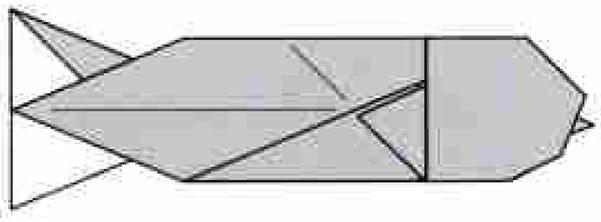
43



44



45



37
Fold and unfold.

38
Inside reverse fold.

40
Inside view.
Angle bisector.

41
Angle bisector.

42
Repeat steps 40 and 41 on the other flap.

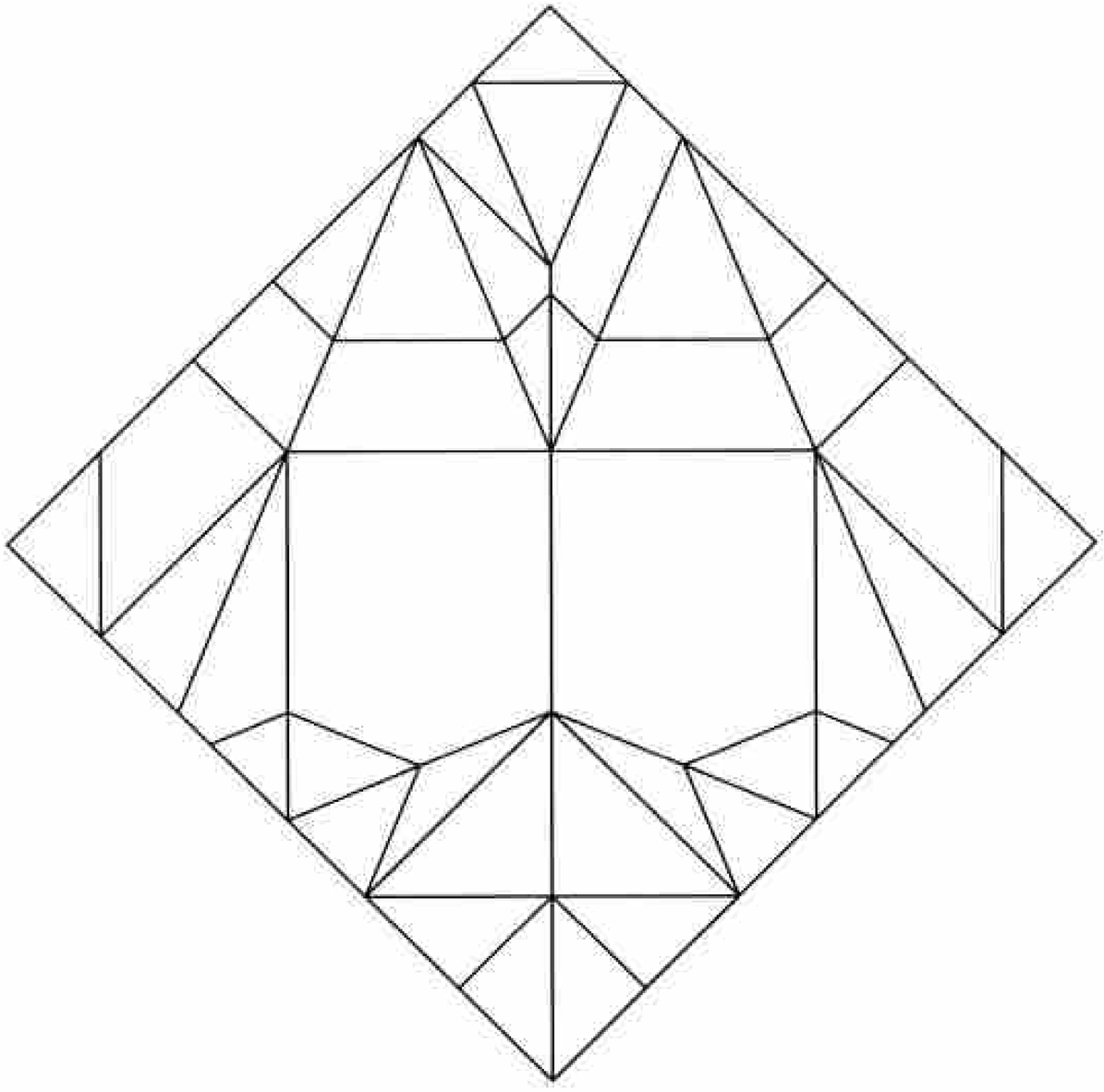
43
Valley fold both layers.

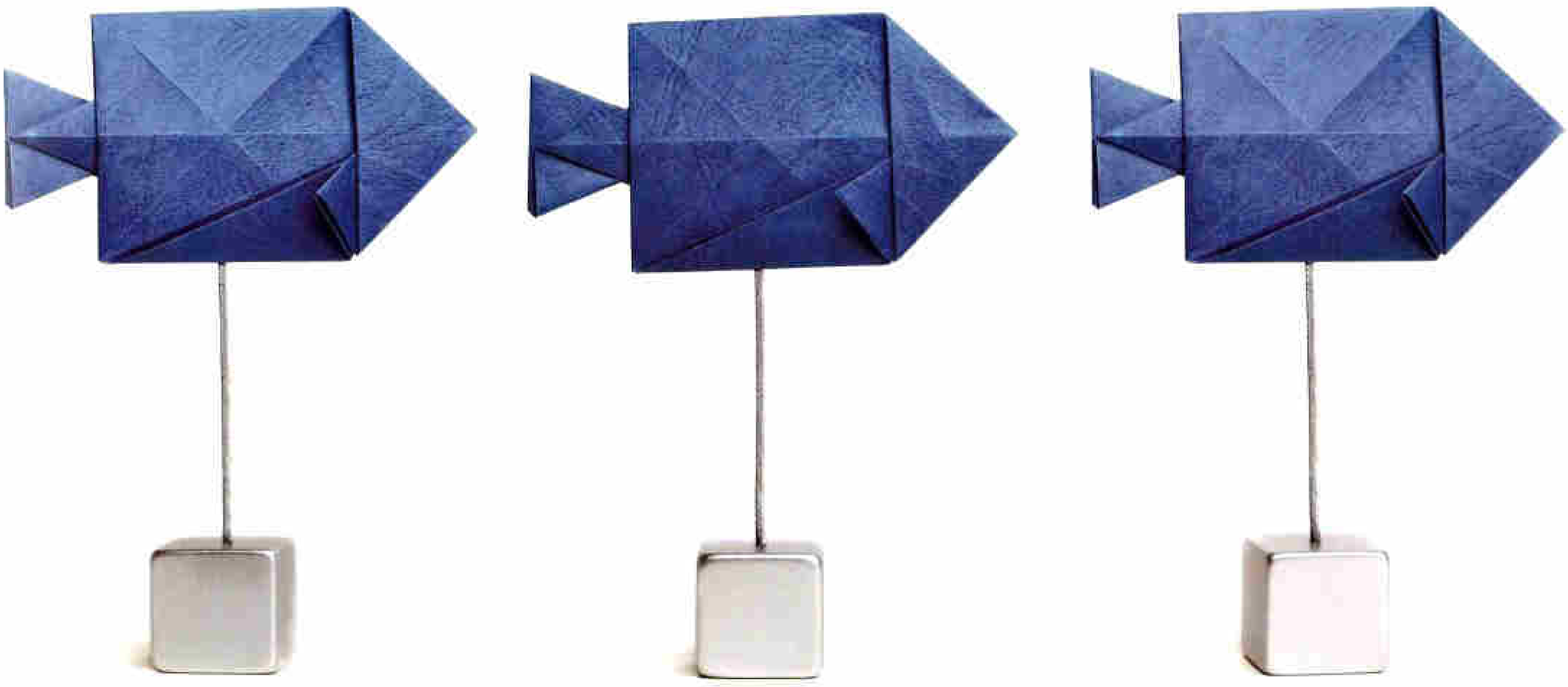
44
Valley fold both layers to complete lock.

45
Fish completed.

Angelfish

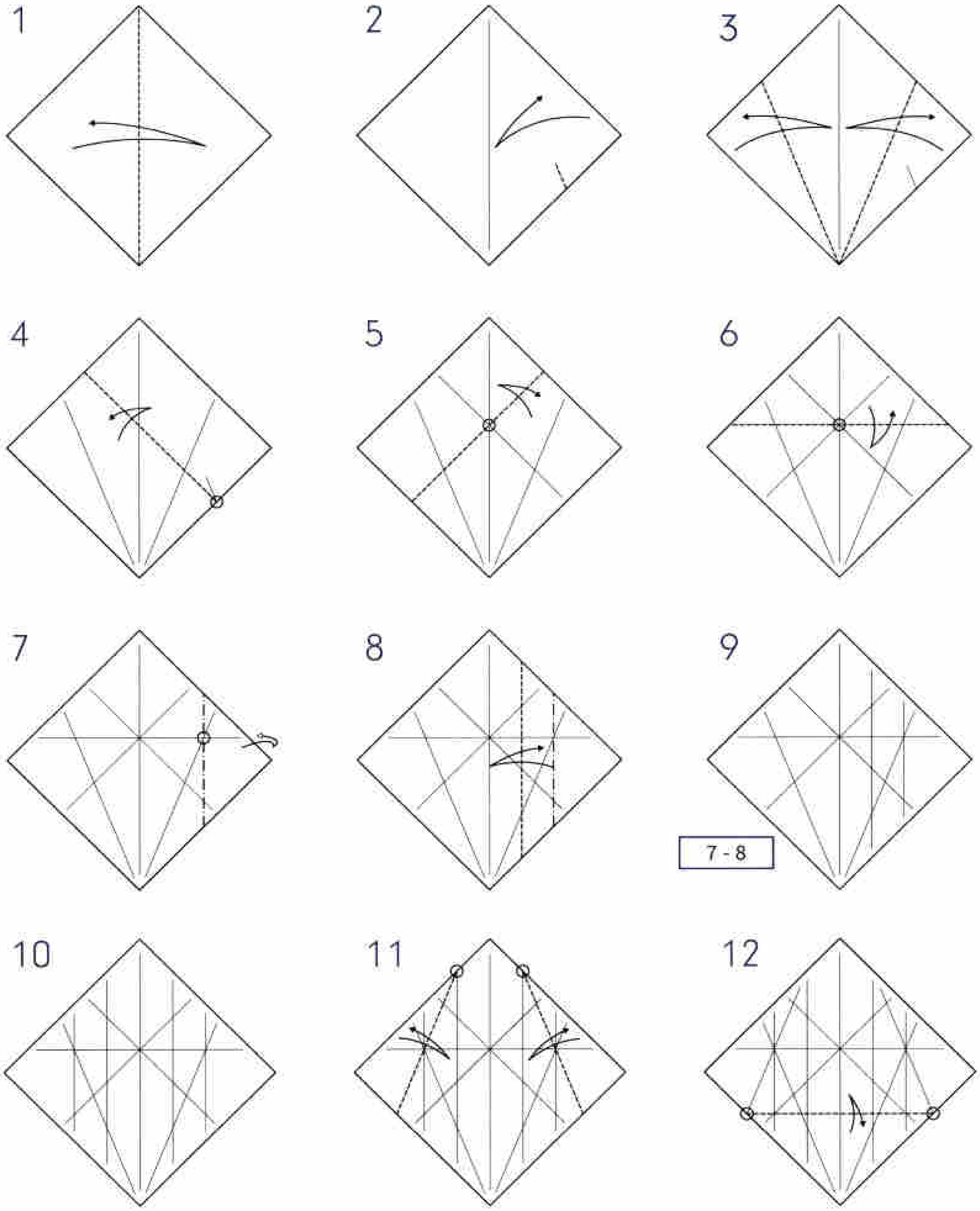
Standard shapes such as the square body and the triangular head define this piece. One of the challenges in origami is optimizing a sheet of paper into a figure. Restricting the angles to only multiples of 22.5° makes this challenge even greater. That is what attracts me to this style of design. The angelfish looks deceptively simple in appearance, but requires a number of precisely placed precreases to achieve the correct ratios. This model, along with the fish, are two of my earliest 22.5° designs.



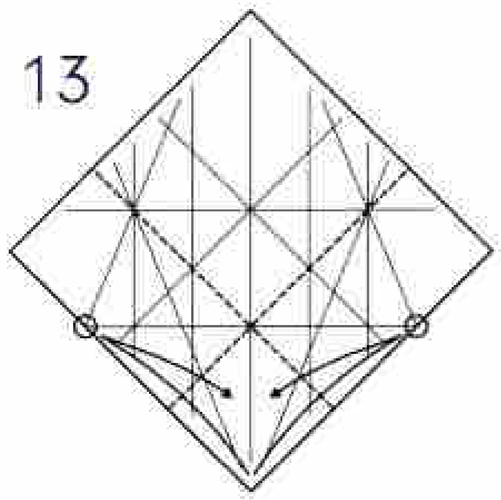


2
Angle bisector.
Crease only at
the edge.

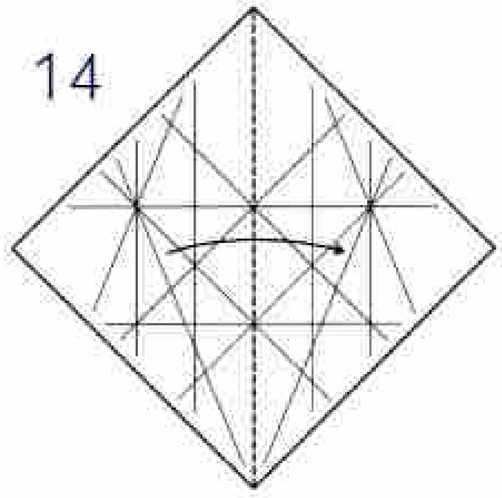
9
Repeat steps 7
and 8 on the left
side.



13

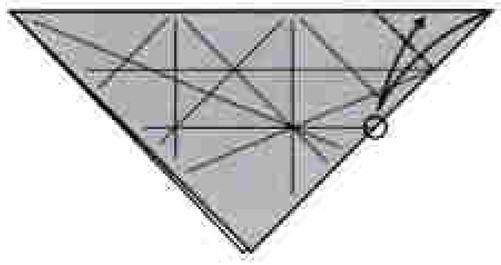


14





15

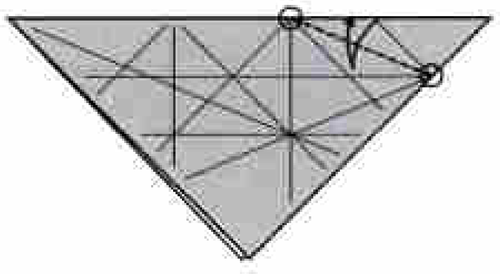


22
Inside reverse fold.

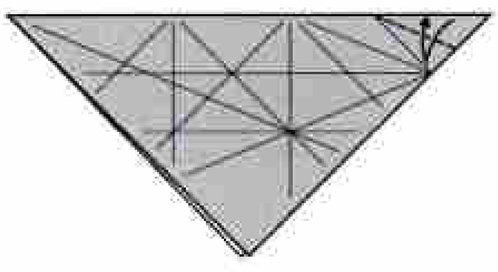
23
Inside reverse fold.

24
Reverse the front flap.

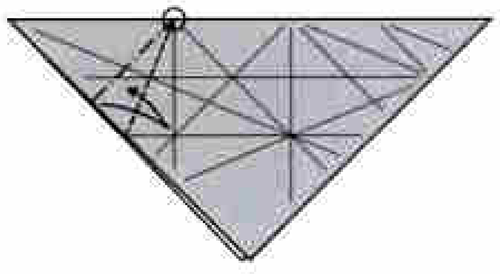
16



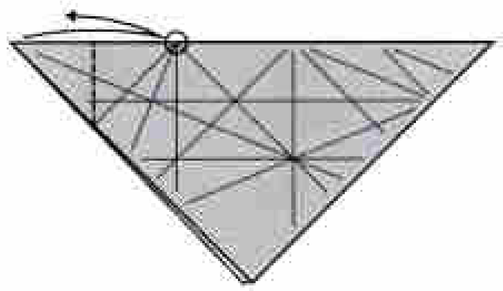
17



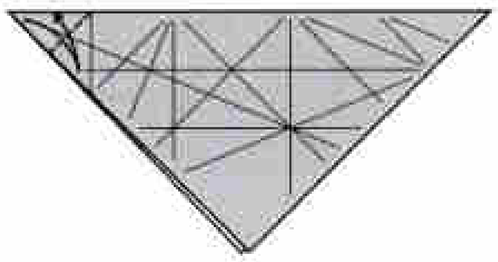
18



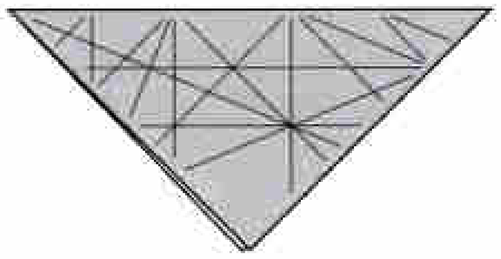
19



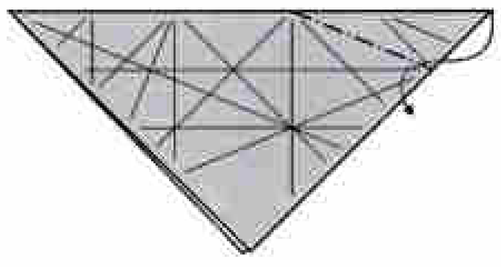
20



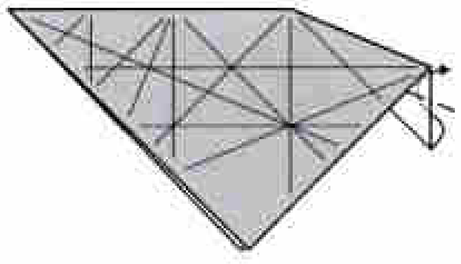
21



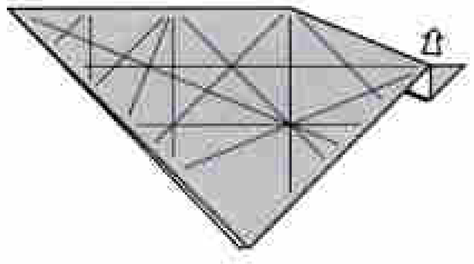
22



23



24



25
Tuck inside.

26
Fold inside.
Repeat behind.

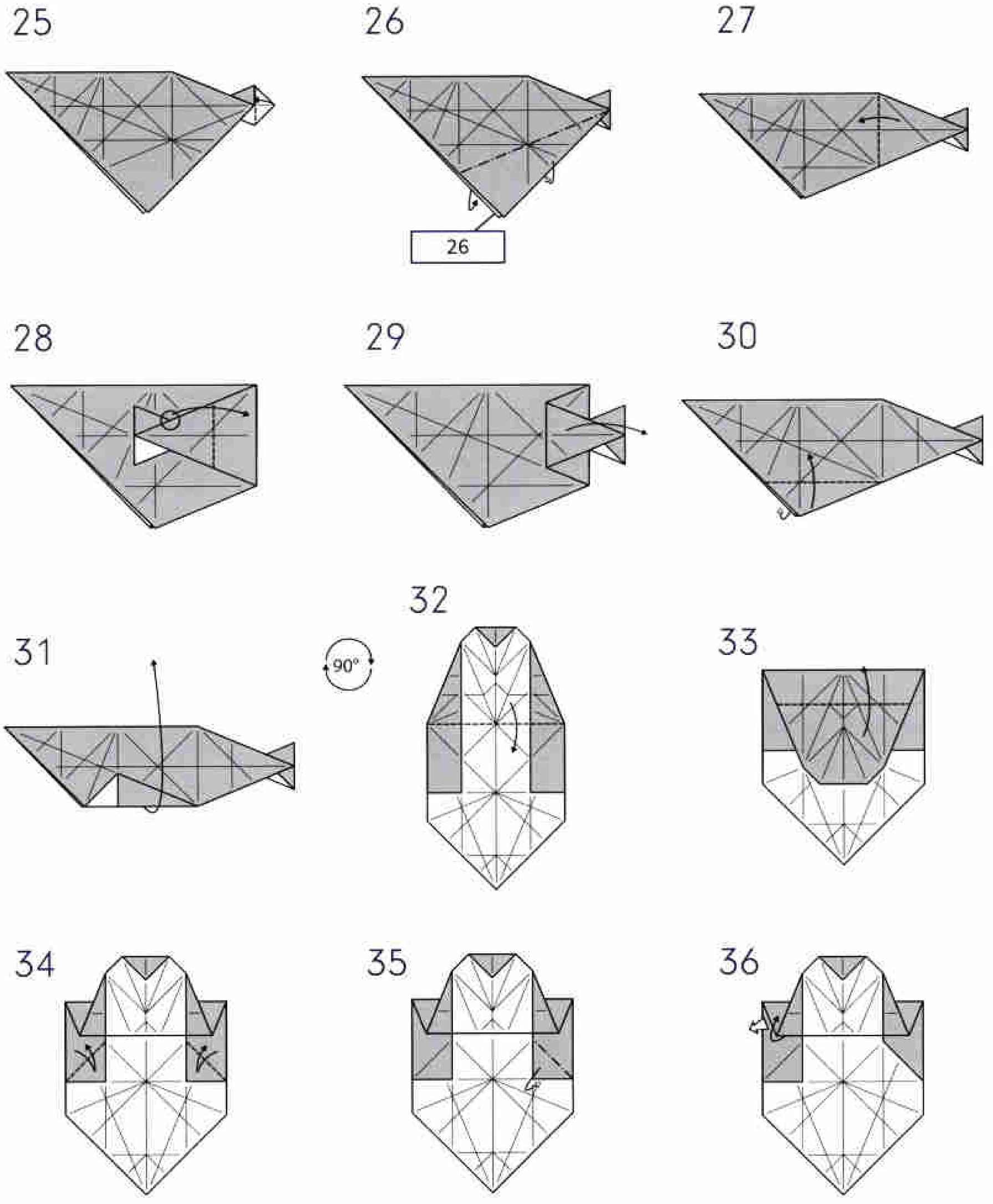
28
Fold reference
point to edge.

29
Open to step 27.

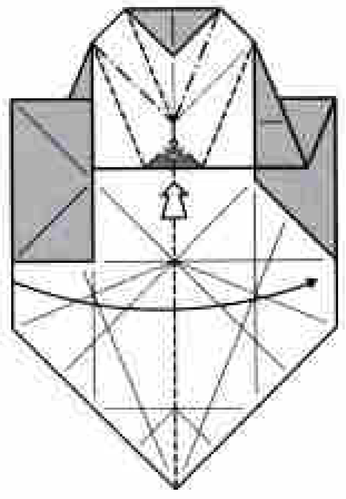
31
Open and
rotate.

35
Mountain fold
the right side
only.

36
Inside out the
creases on the
left.

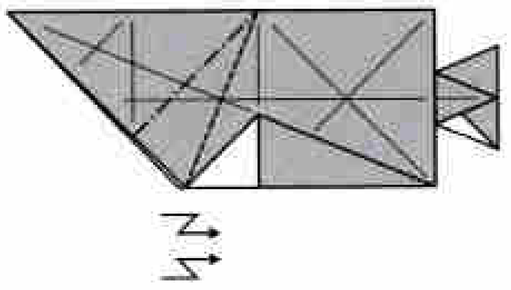


37

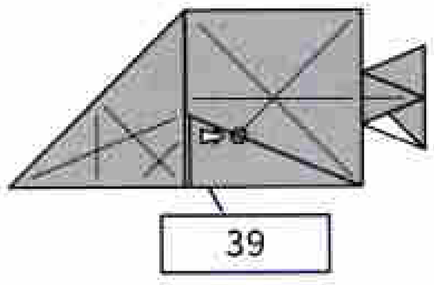


90°

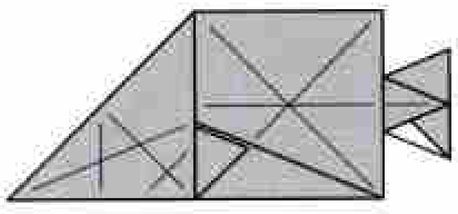
38



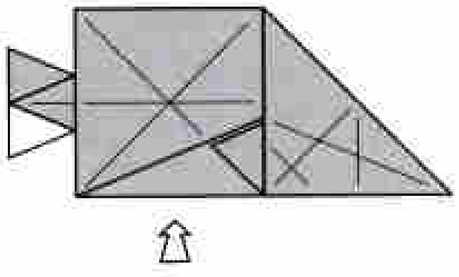
39



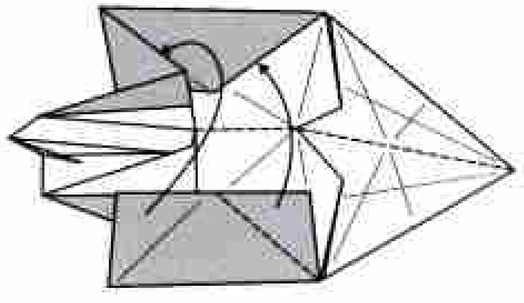
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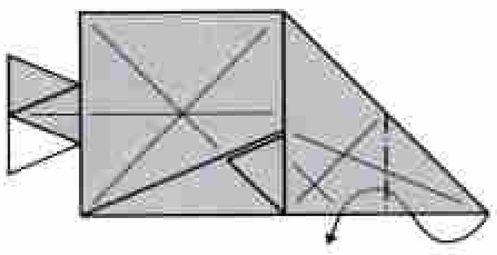
41



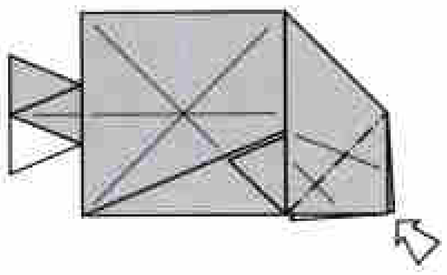
42



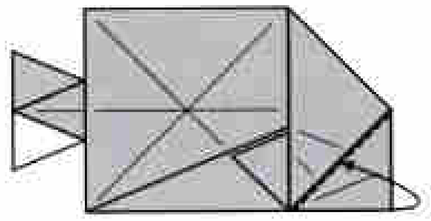
43



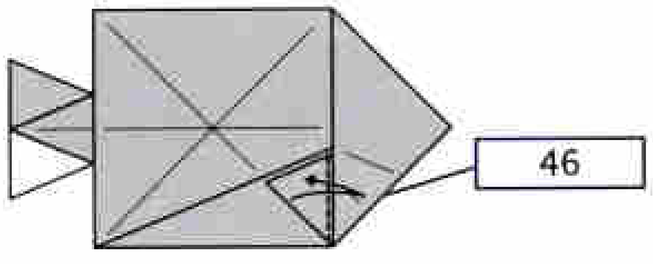
44



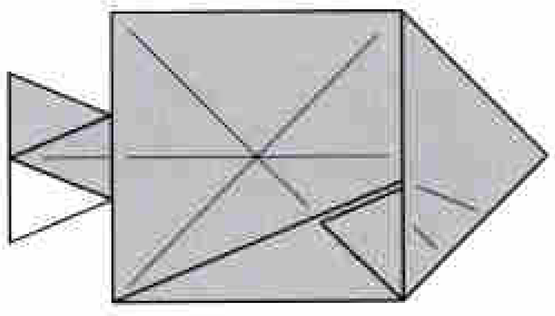
45



46



47



37
Collapse on the existing creases. Push in at the dark area.

38
Crimp.

39
Pull out fin to the reference point. Repeat behind.

41
Underside view.

42
Lock the body by inserting the flaps into the pockets.

43
Inside reverse fold.

44
Inside reverse fold.

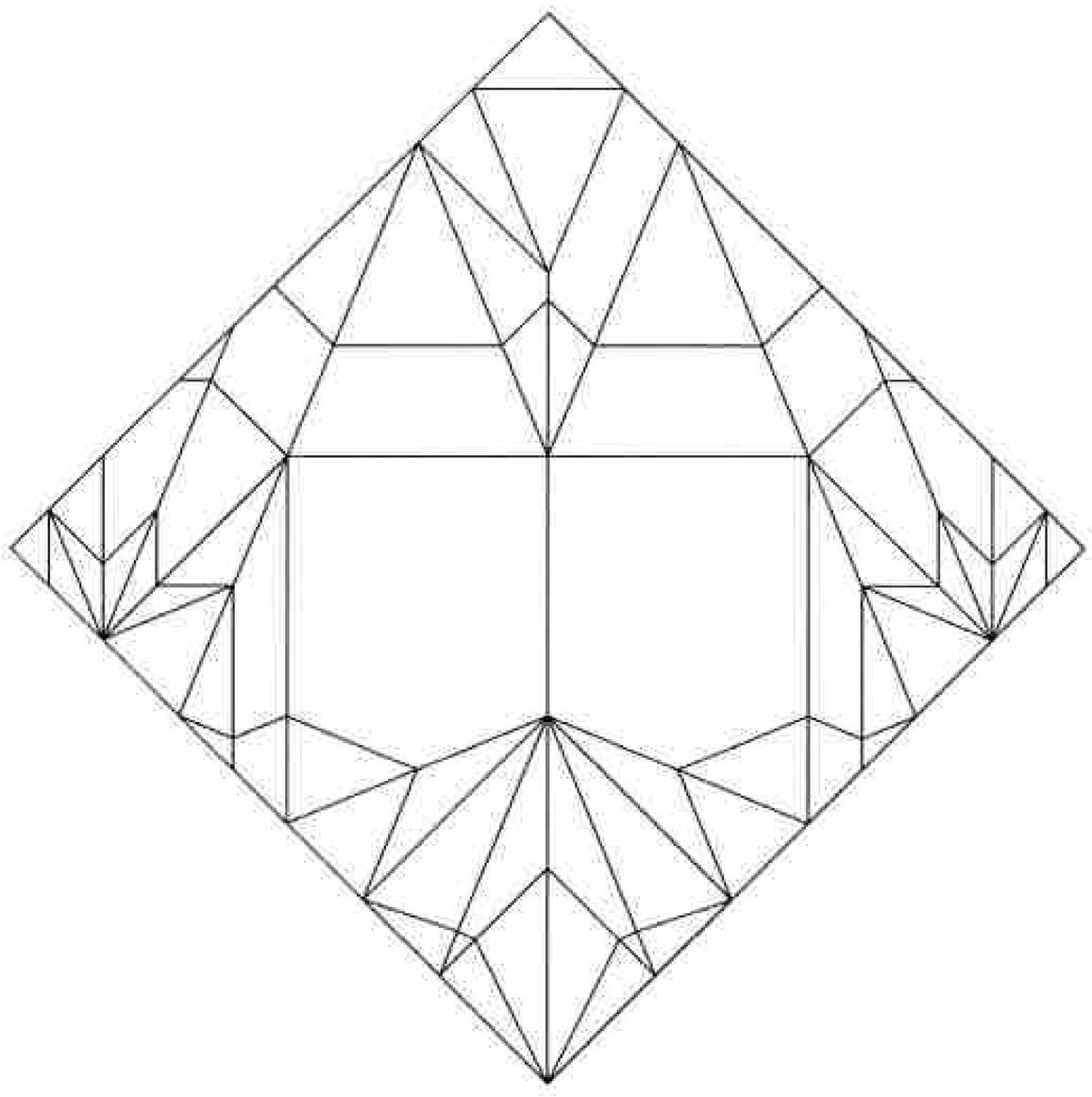
45
Insert flap into pocket.

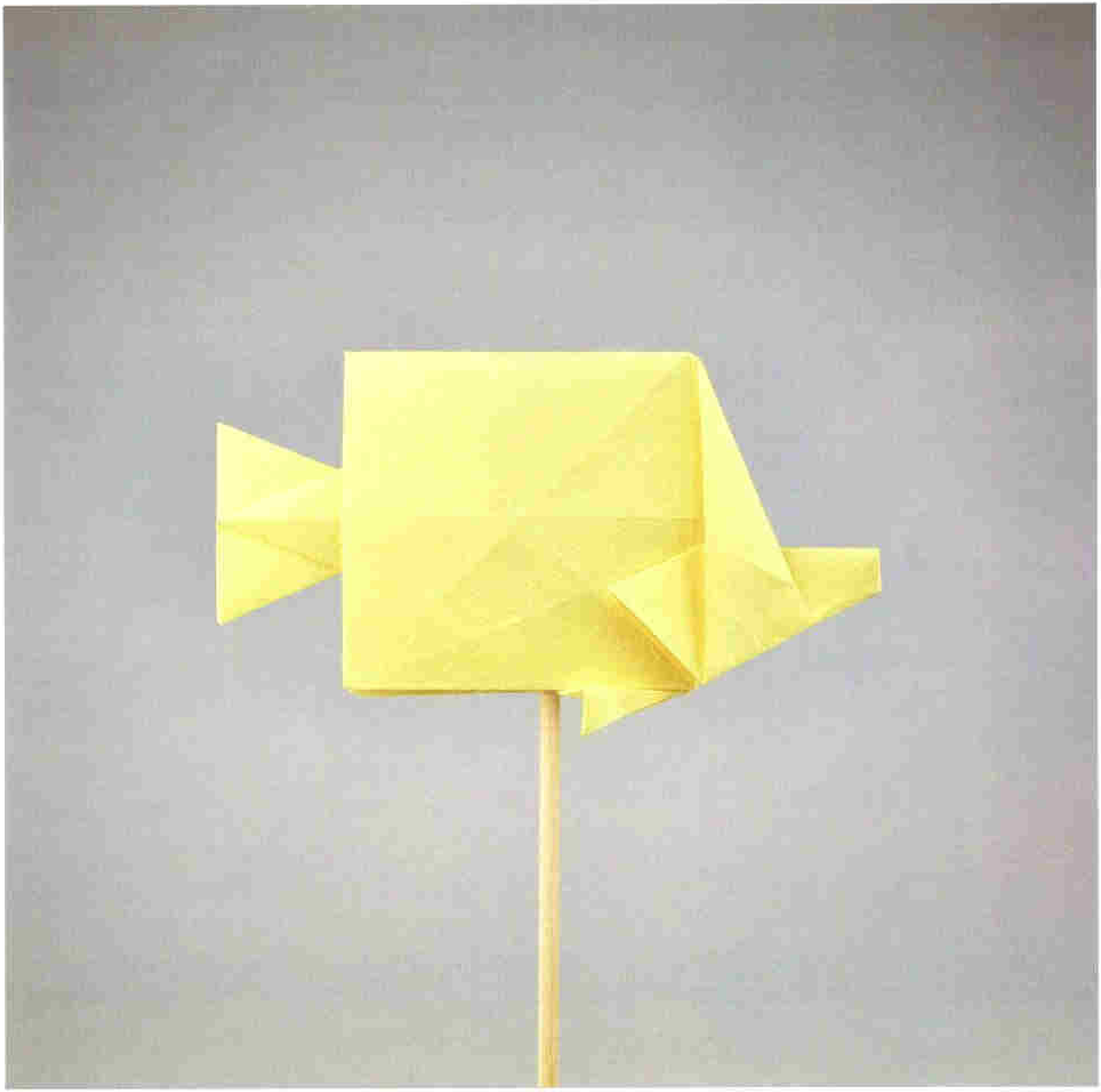
46
Fold and unfold. Repeat behind.

47
Angelfish completed.

Butterflyfish

The butterflyfish shares the same starting base as the angelfish. The variation lies in the fins and head structures. This model includes pelvic fins and a narrow mouth. An easy way to quickly improve your design skill is to create variations from the same or similar base.





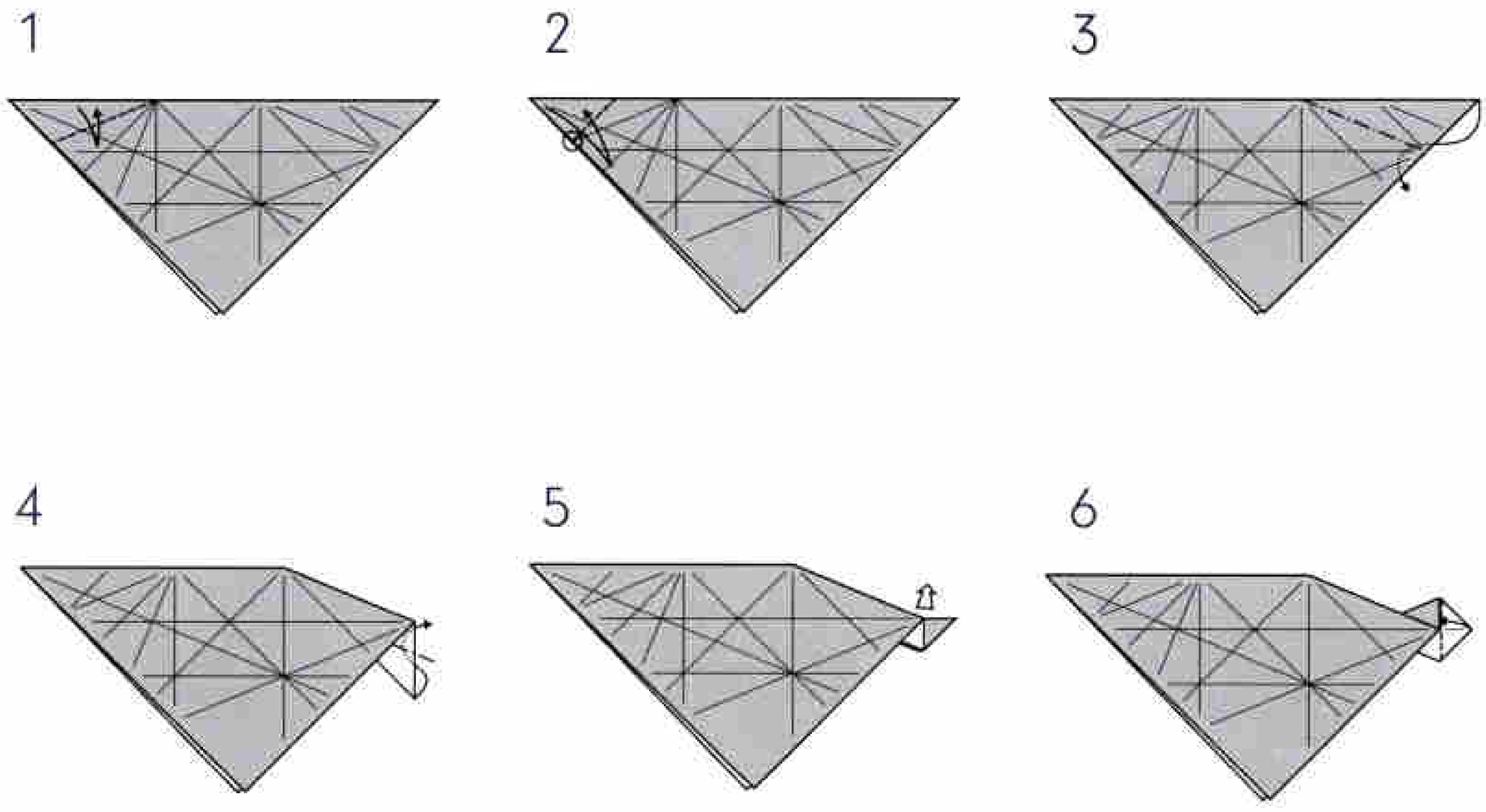
1
Start after step 18 of the angel-fish.

9
Bring reference point to edge.

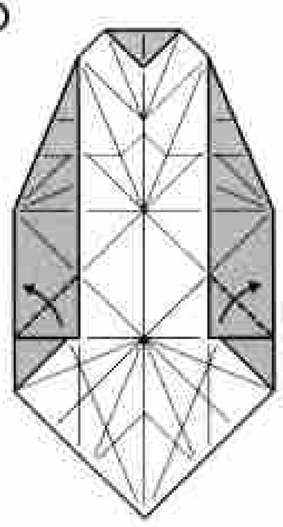
10
Fold and unfold. Repeat behind.

11
Inside reverse fold. Repeat behind.

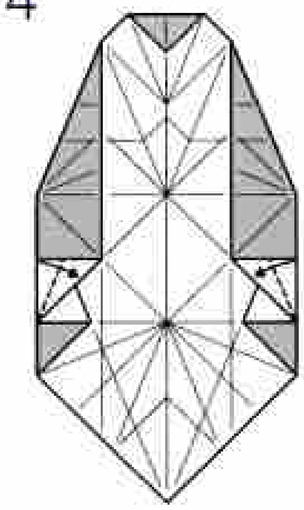
12
Open model.



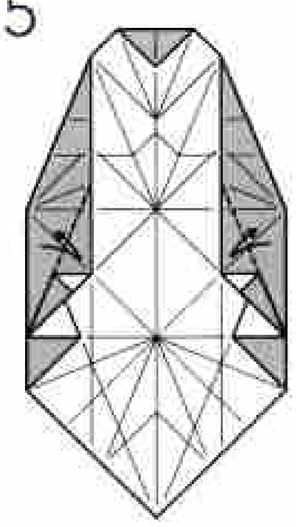
13



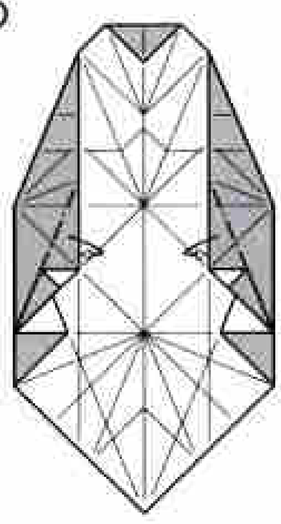
14



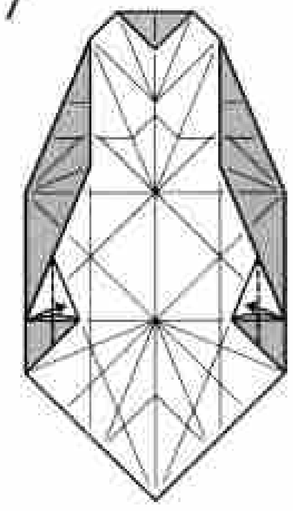
15



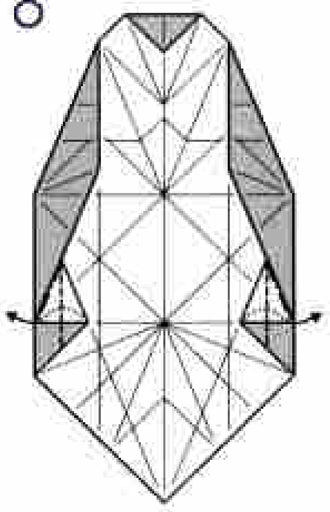
16



17



18



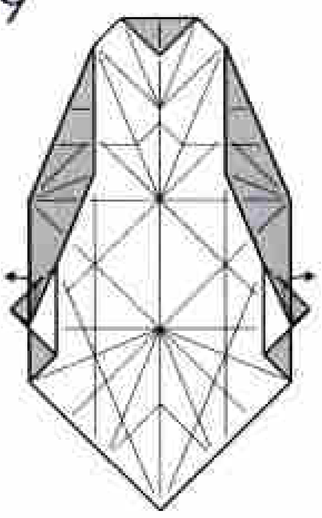
18
Inside reverse folds.

19
Inside reverse folds.

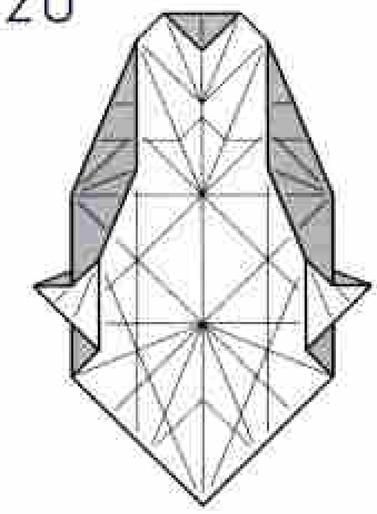
23
Inside out the flap.

24
Collapse. Push in the dark area. Tuck flap into pocket. Rotate.

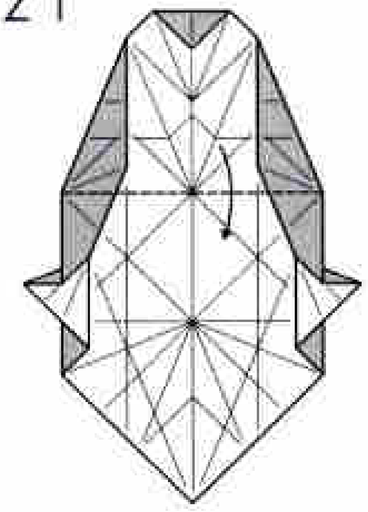
19



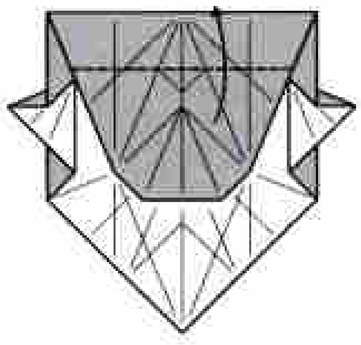
20



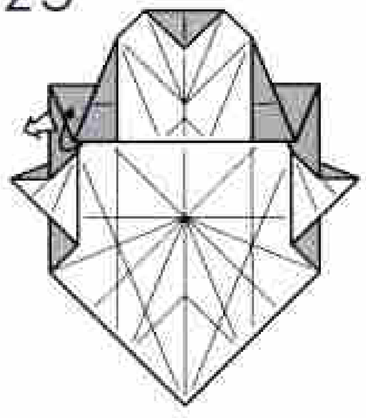
21



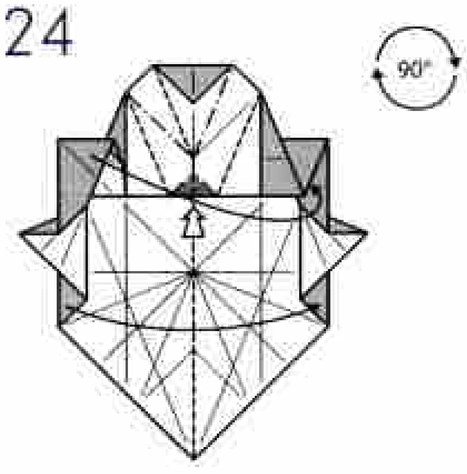
22



23



24



25
Crimp.

26
Pull out the fin to the reference point. Repeat behind.

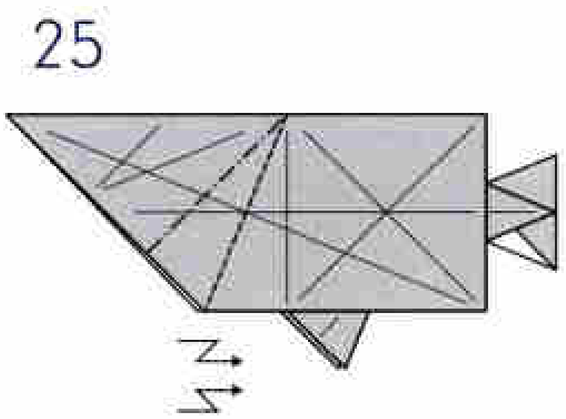
29
Fold and unfold. Repeat behind.

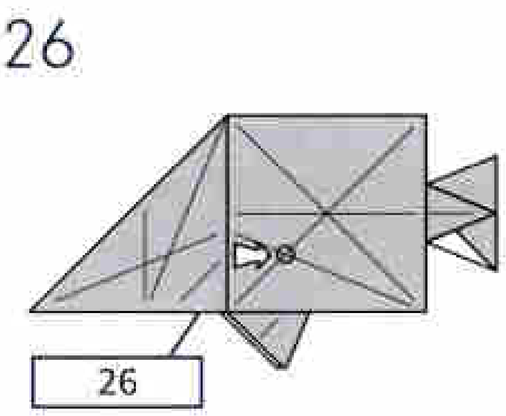
30
Mountain fold. Repeat behind.

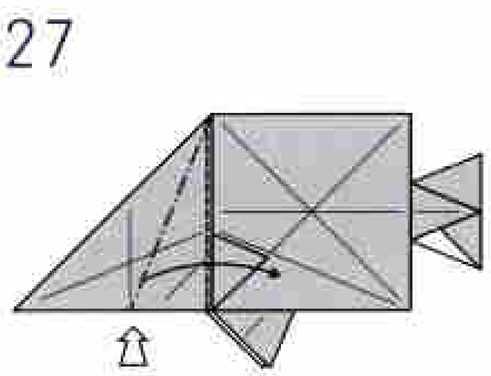
32
Underside view.

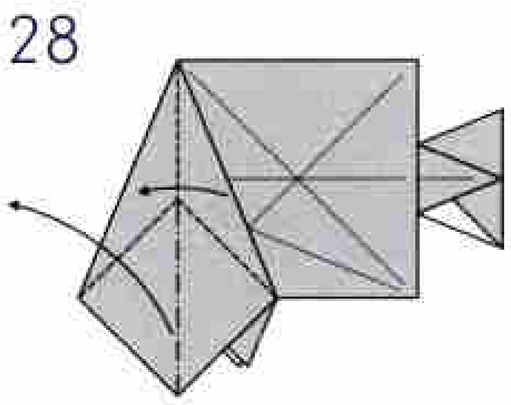
35
Tuck flap behind and close head.

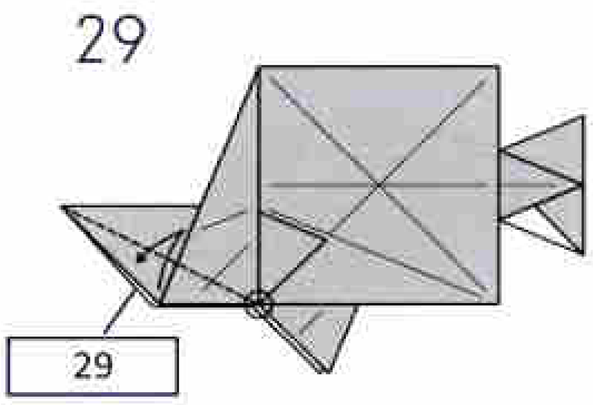
36
Fold and unfold. Repeat behind.

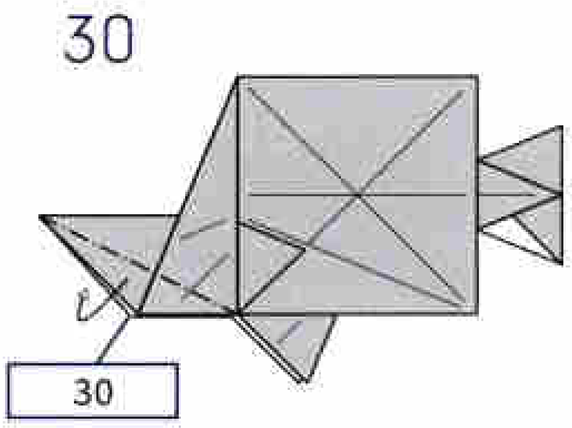


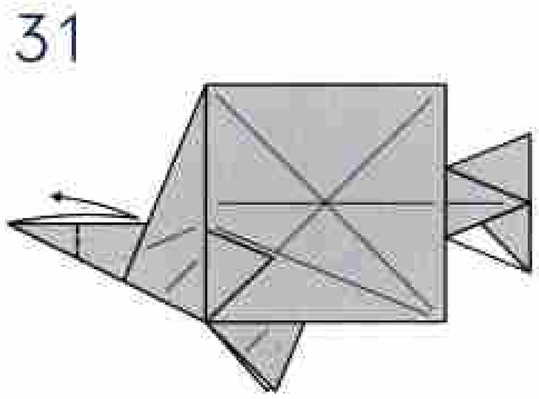


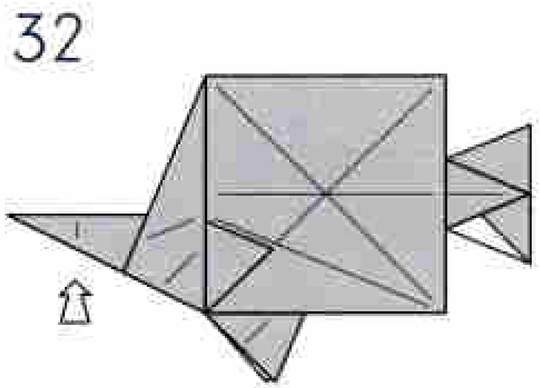


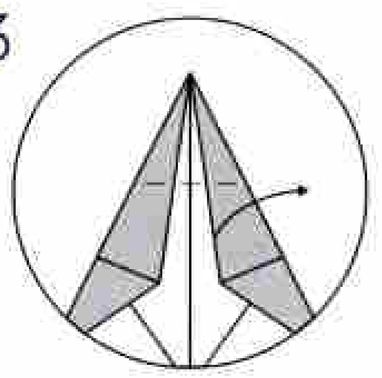


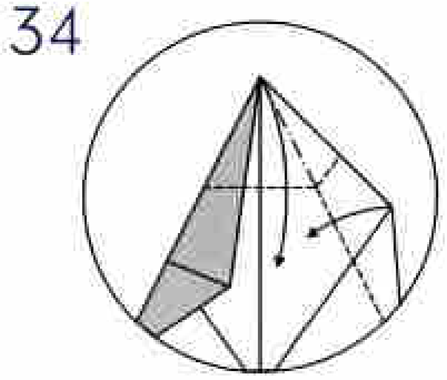


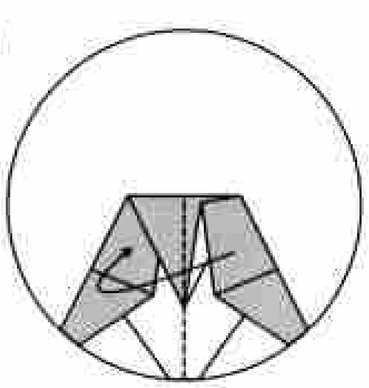


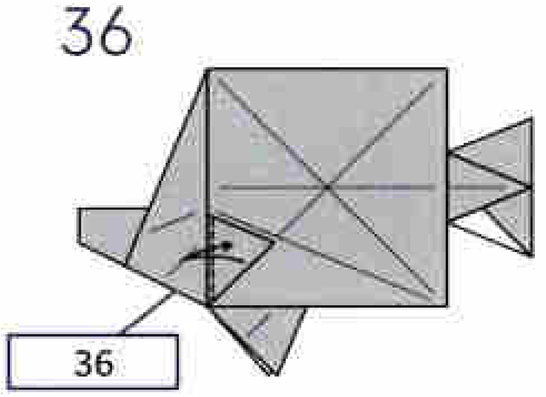








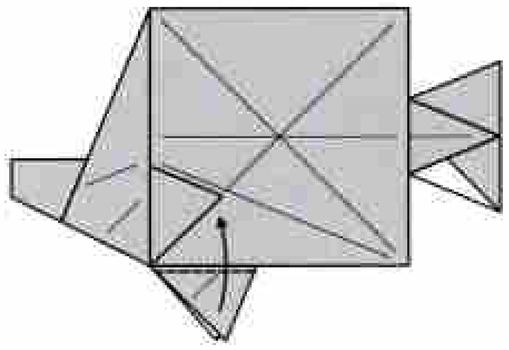




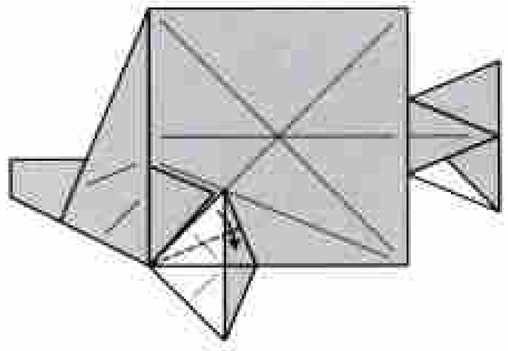
39
Repeat steps 37 and 38 behind.

40
Butterflyfish completed.

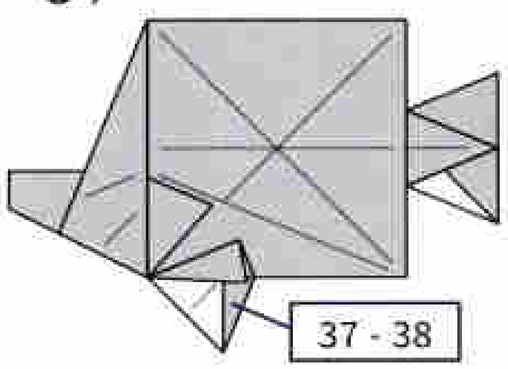
37



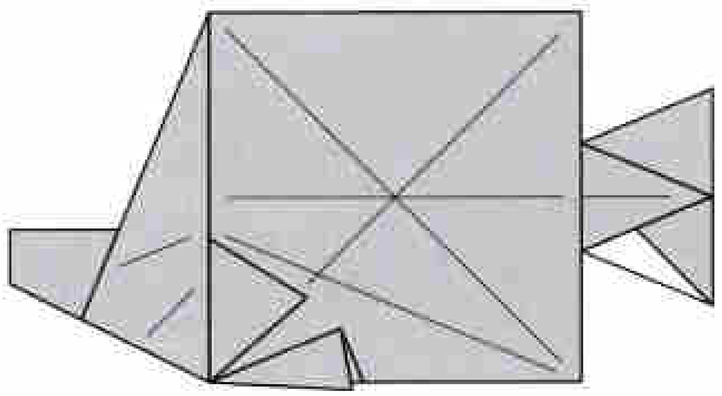
38



39

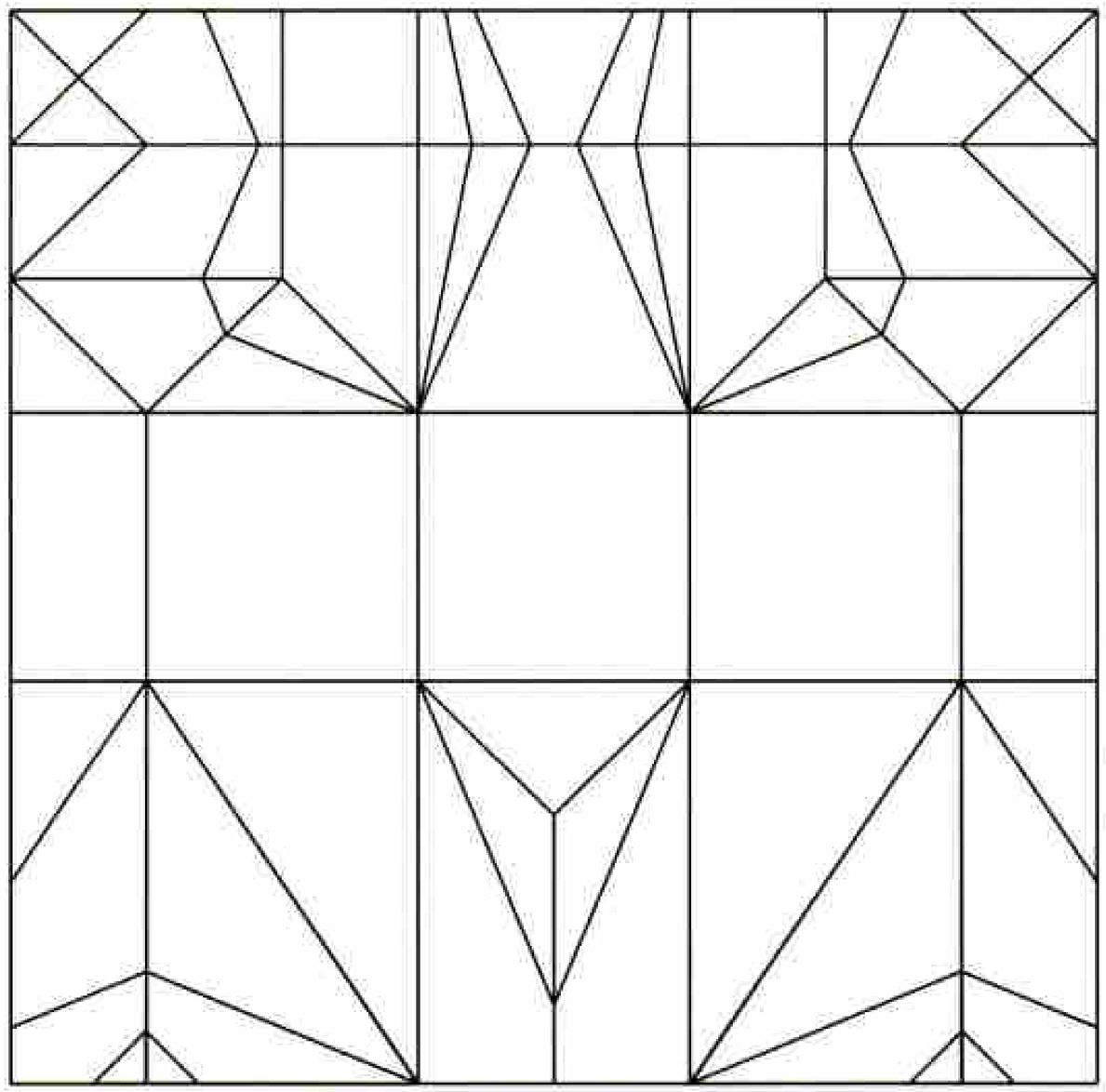


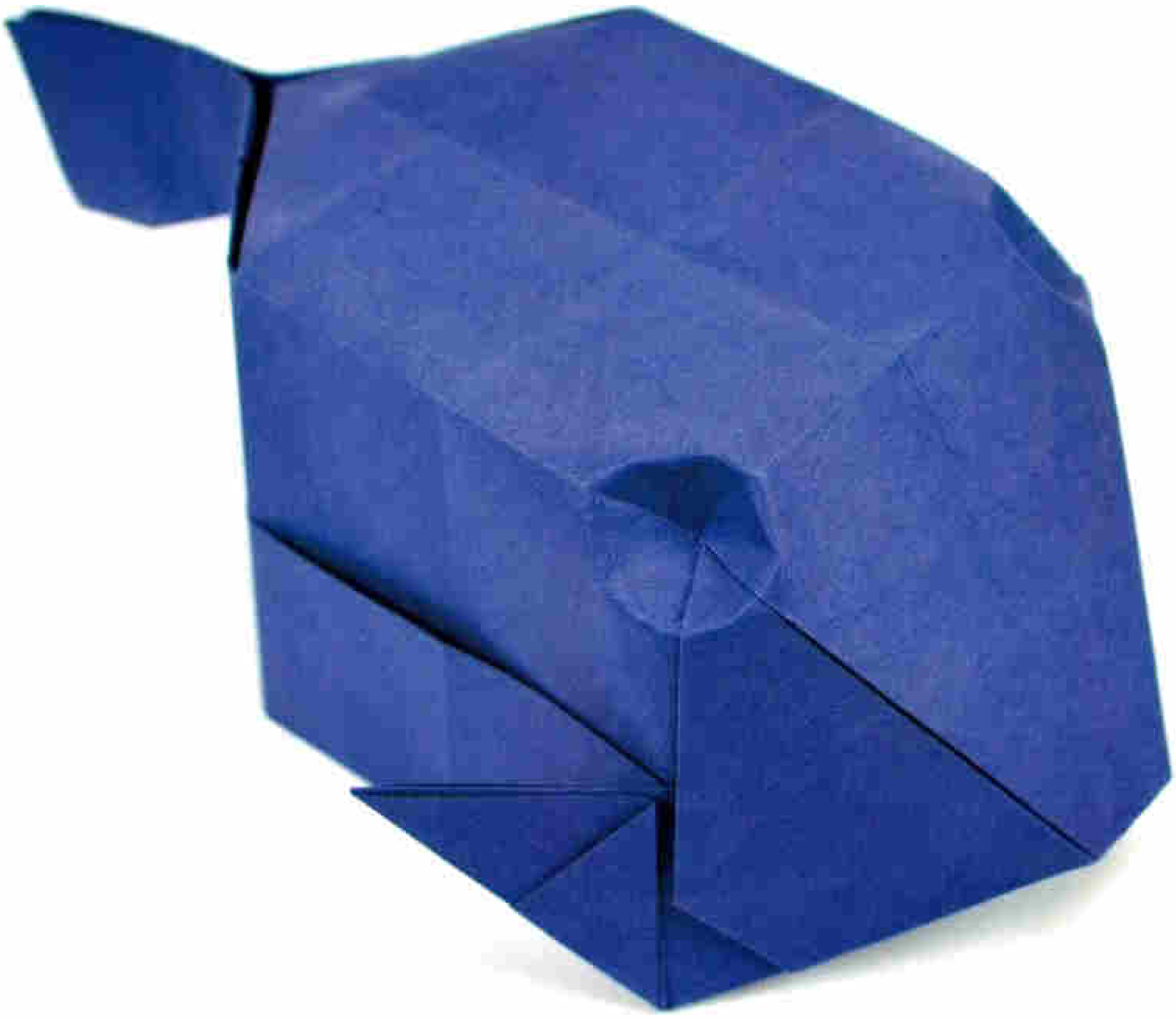
40



Boxfish

After observing dozens of these fish swimming along the docks at a beach in Mexico, I felt compelled to add this subject to my collection of designs. Naturally, the boxiness of this subject led me to base the design off a simple eight-by-eight grid. A few small folds underneath the front of the model lock the head folds in place, and a pinch collapse closes the backside into a tail.

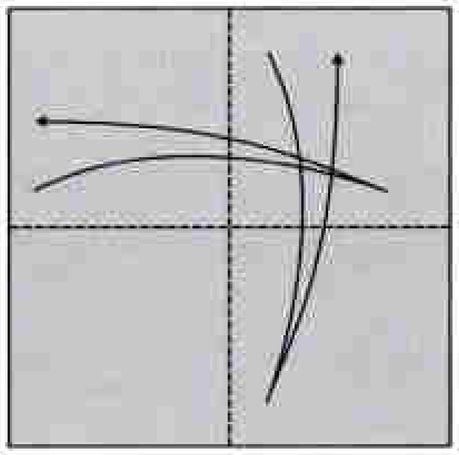




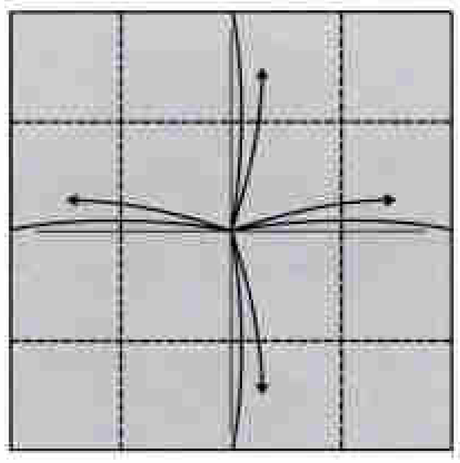
11
Collapse.

12
In progress.

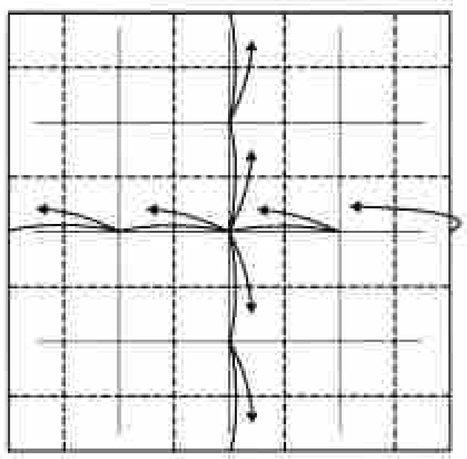
1



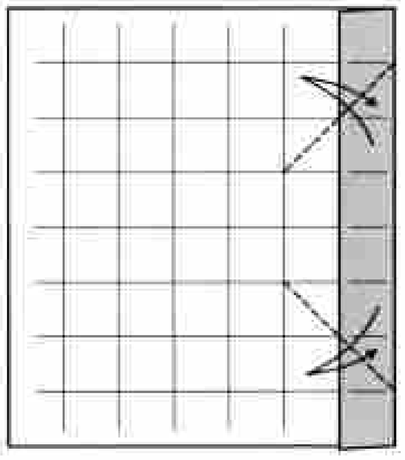
2



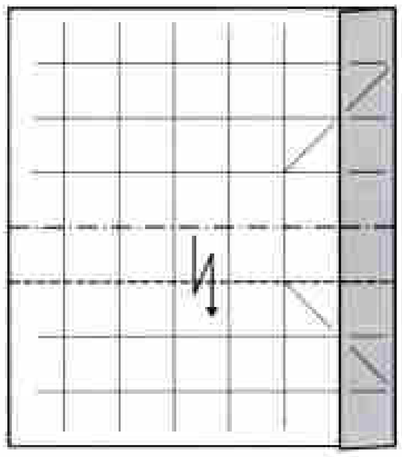
3



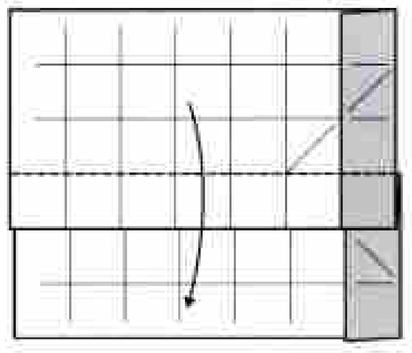
4



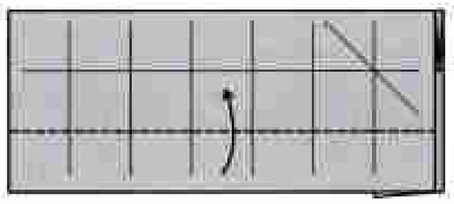
5



6



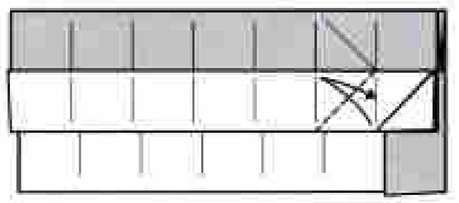
7



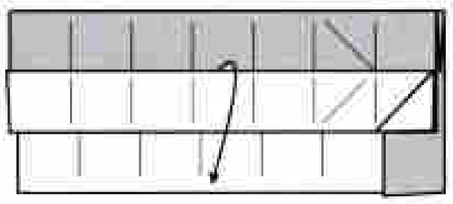
8



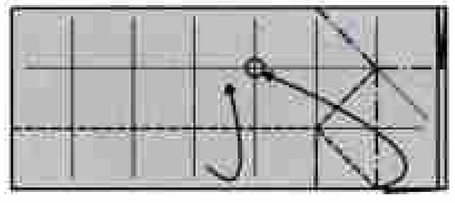
9



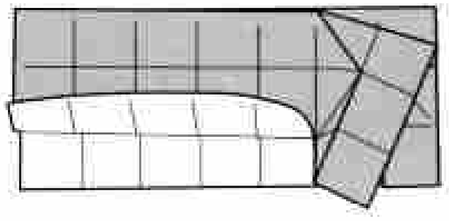
10



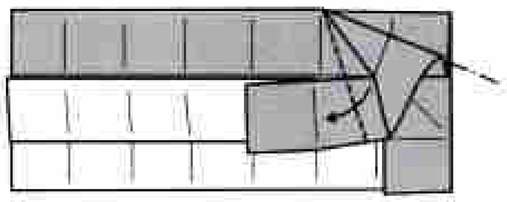
11



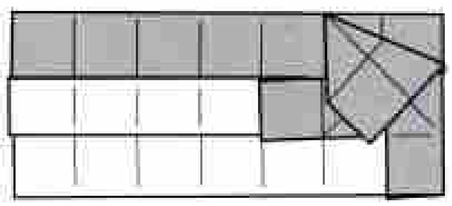
12



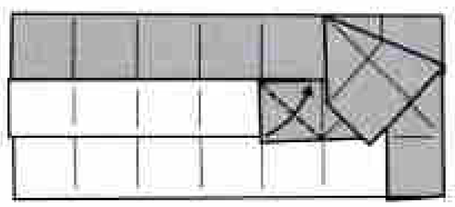
13



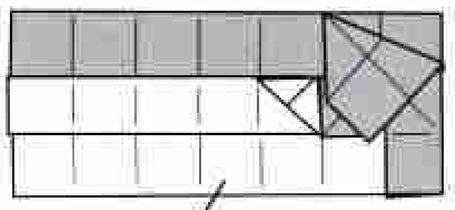
14



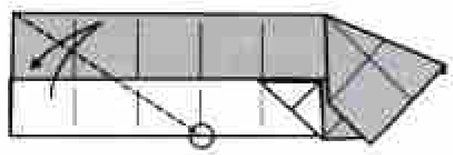
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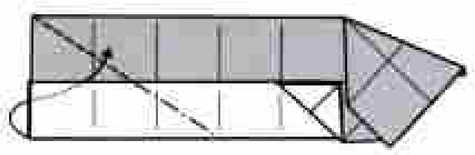
16



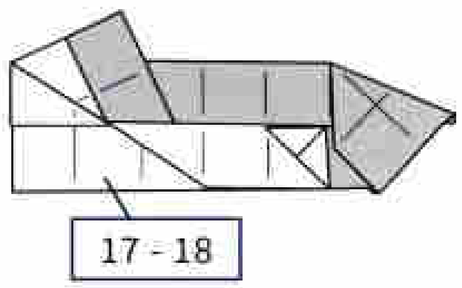
17



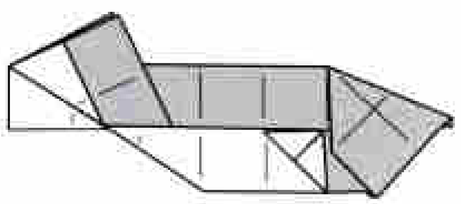
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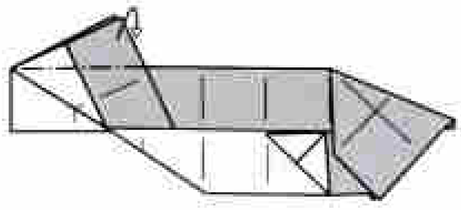
19



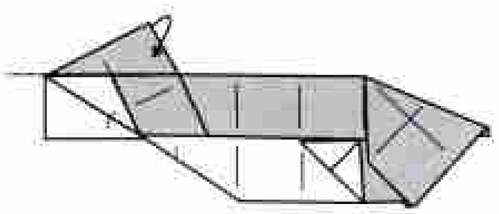
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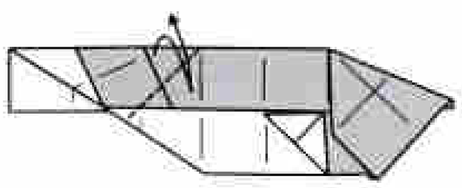
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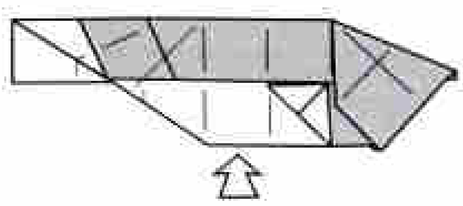
22



23



24



13
Angle bisector.

14
Angle bisector completed.

16
Repeat steps 7 to 15 behind.

18
Inside reverse fold.

19
Repeat steps 17 and 18 behind.

21
Mountain fold.

22
Valley fold.

23
Angle bisector.

24
Open the model.

26
Fold the angle bisector. Repeat behind.

27
Valley folds.

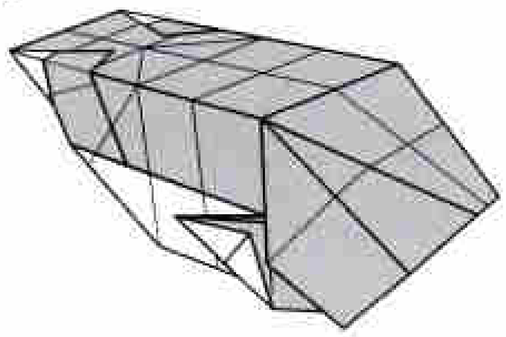
28
Valley folds.

31
Collapse by folding angle bisectors.

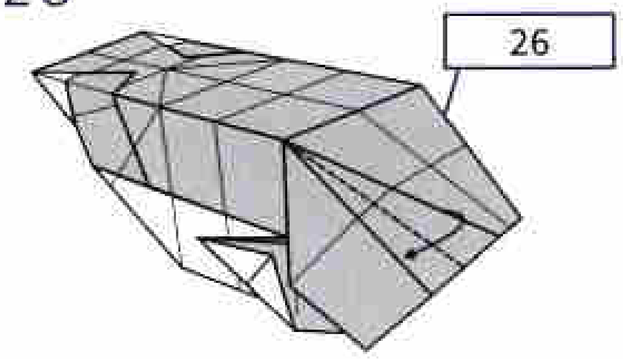
33
Form eyes. Crimp fins.

34
Boxfish completed.

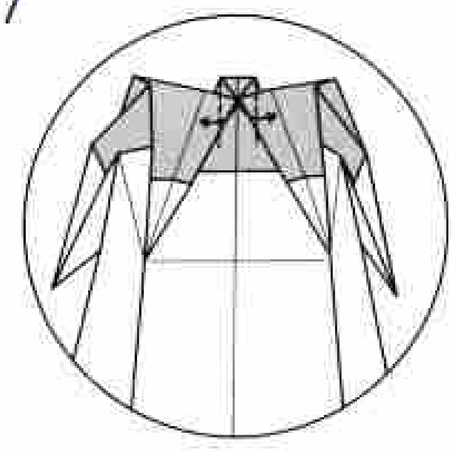
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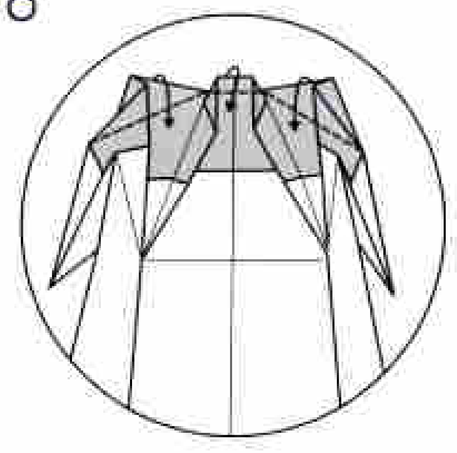
26



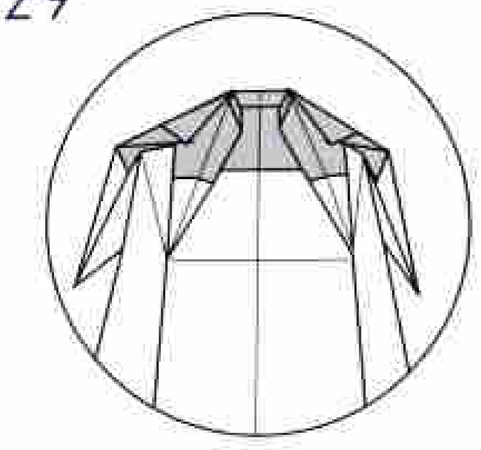
27



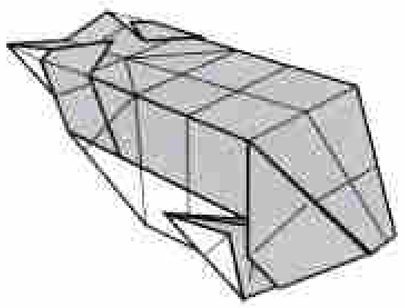
28



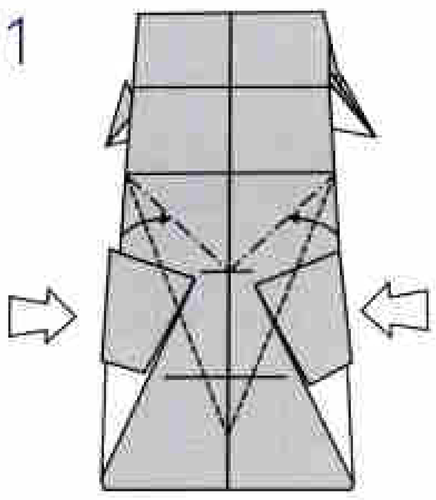
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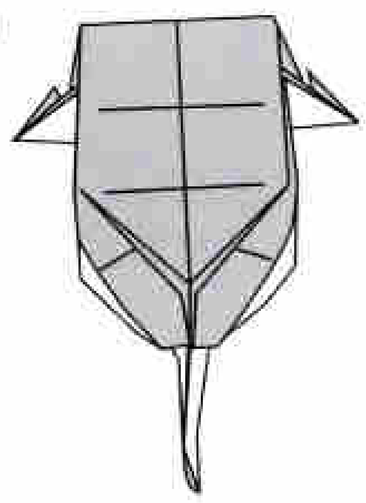
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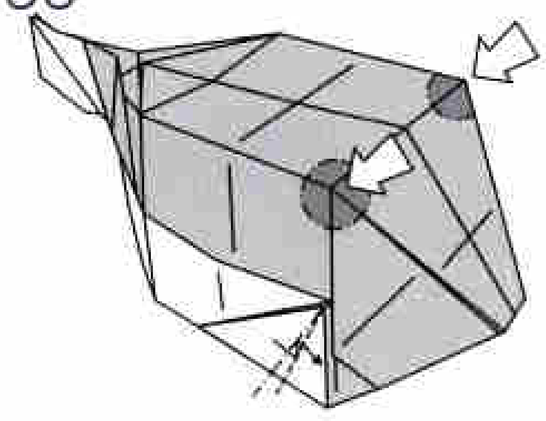
31



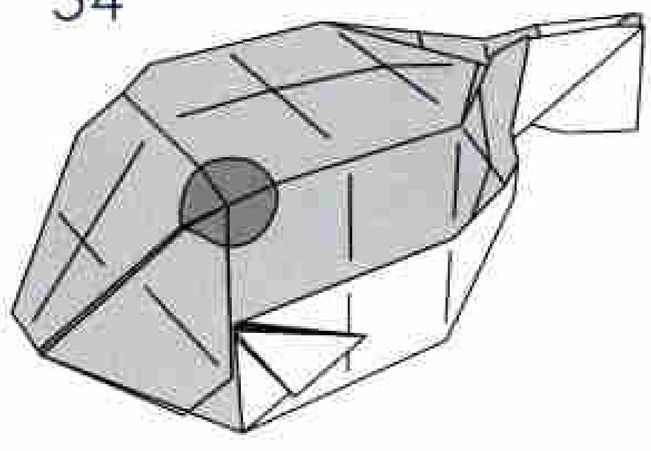
32



33



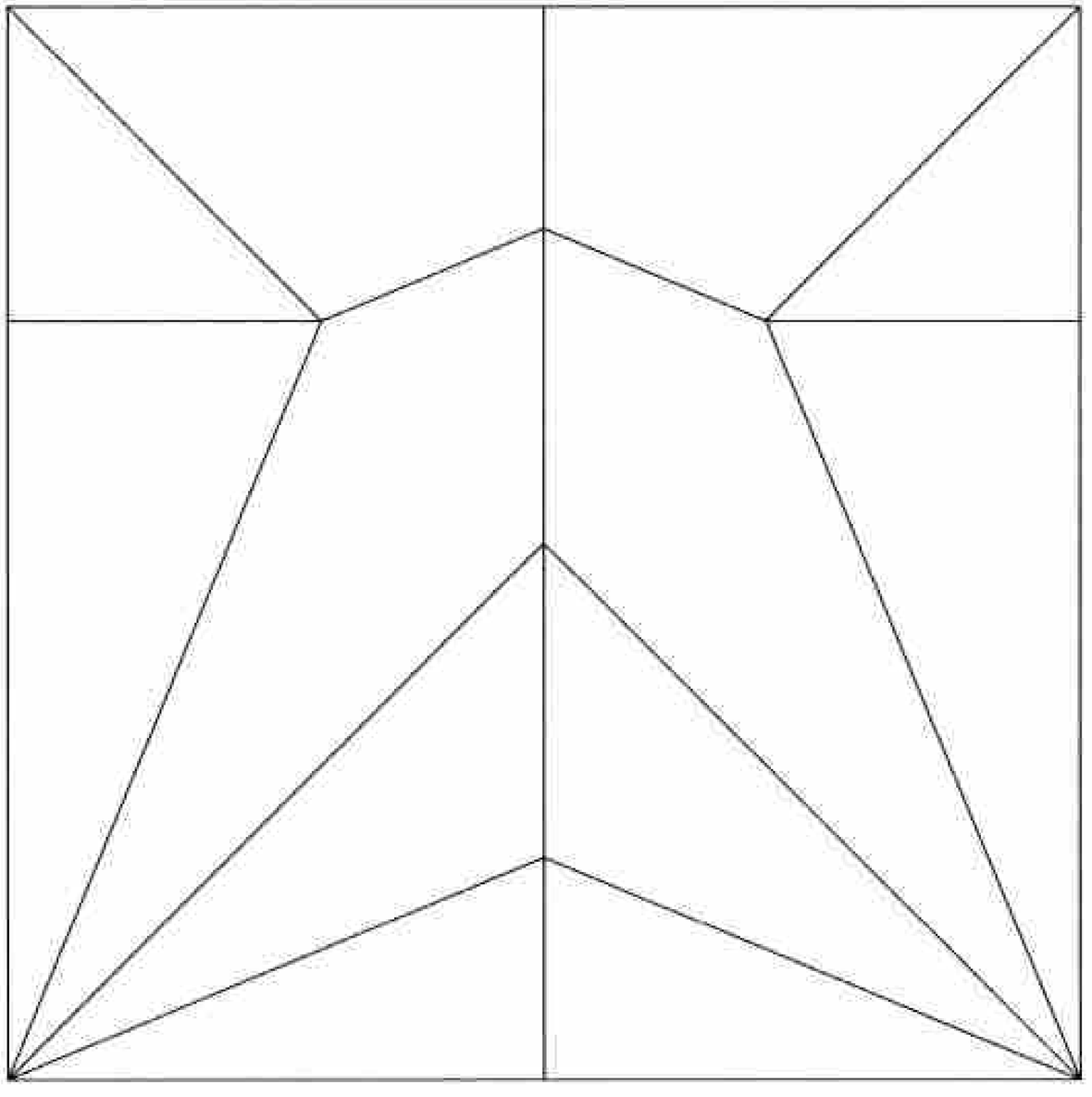
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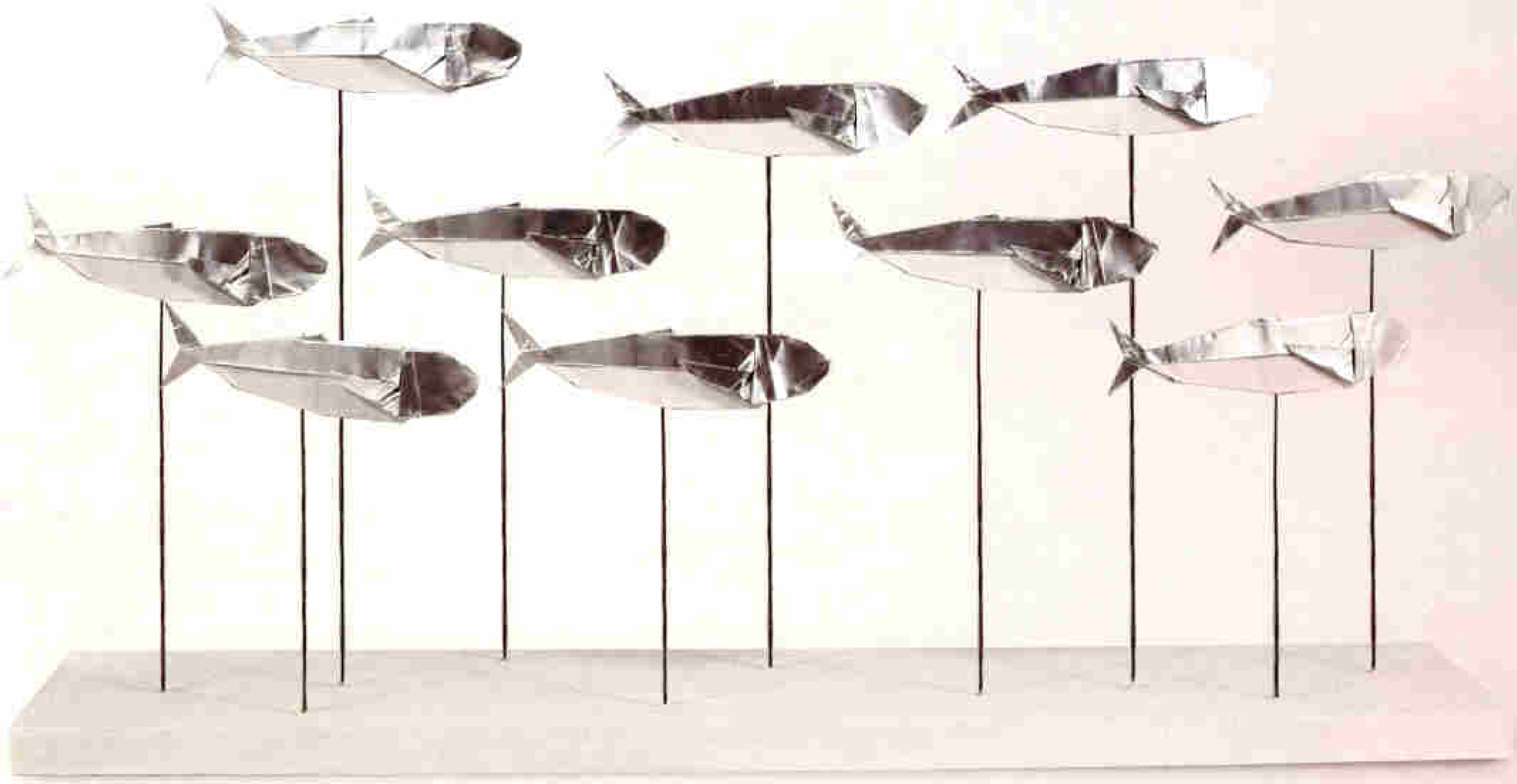


Horse Mackerel

My intention with the horse mackerel was to present it in a multi-piece display. Therefore, I designed this model to be easy to fold, yet easily identifiable. To accomplish this, I eliminated some small fins and included a color change. The tail fins are formed from opposite corners of the same edge. One challenge was trying to incorporate a lower jaw and eyes, but I decided not to include them because a paper graft would make the distribution of paper inefficient, especially at the tail.

Use double sided paper for this model.





7
Unfold.

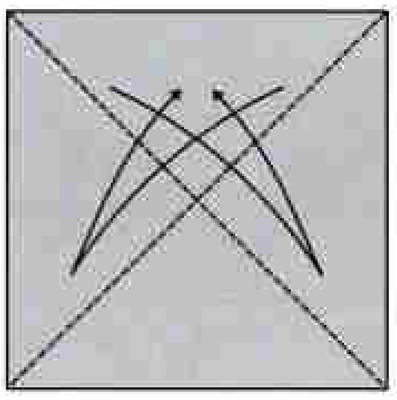
8
Repeat steps 6 and 7 behind.

9
Angle bisector to reference point. Repeat behind.

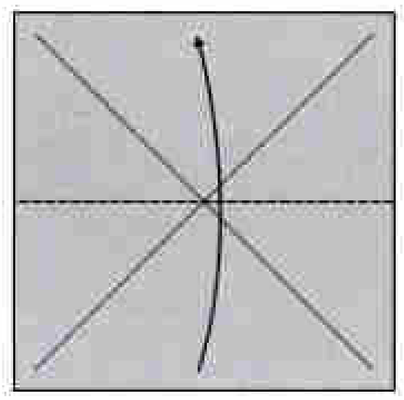
10
Unfold everything.

11
Collapse.

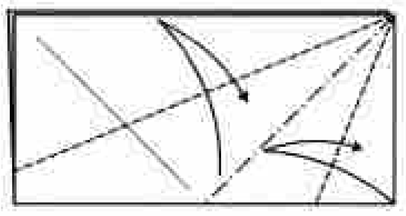
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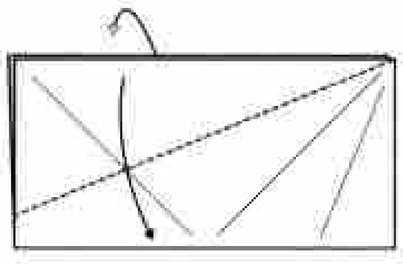
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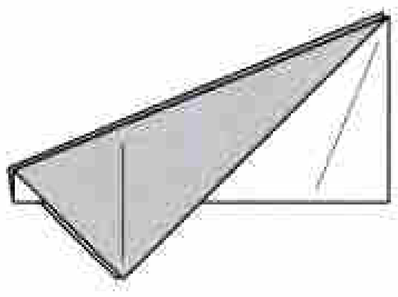
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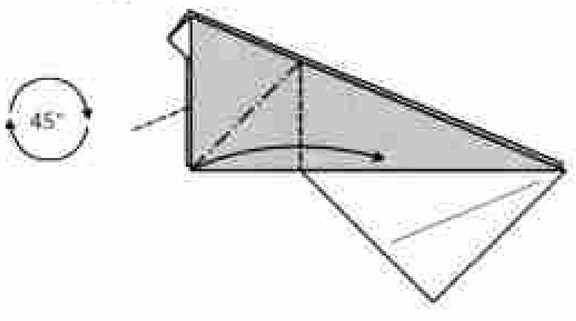
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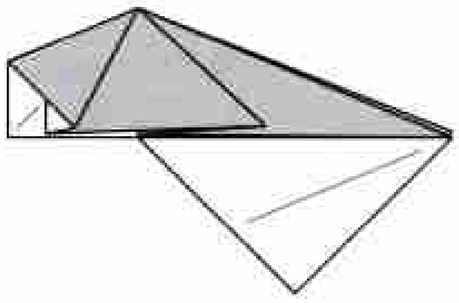
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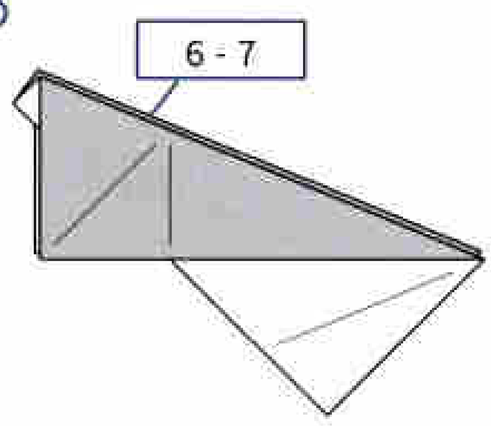
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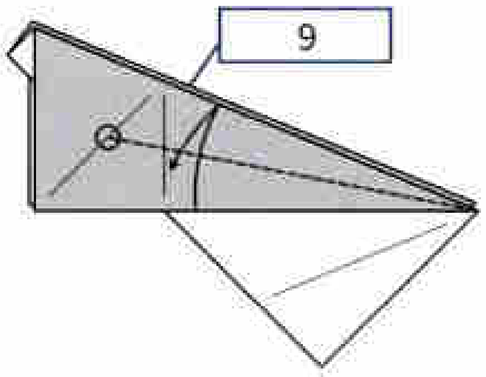
7



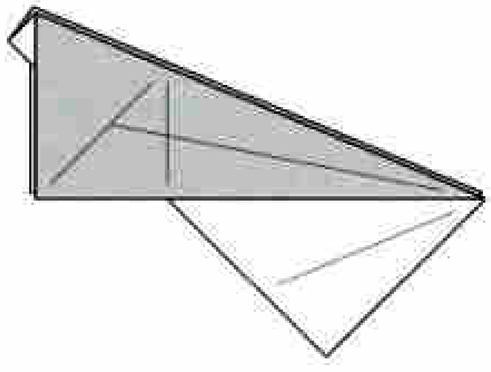
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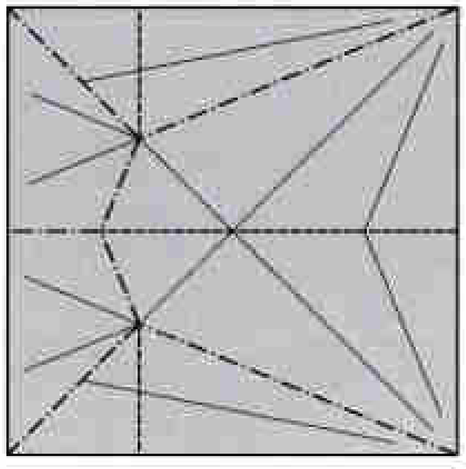
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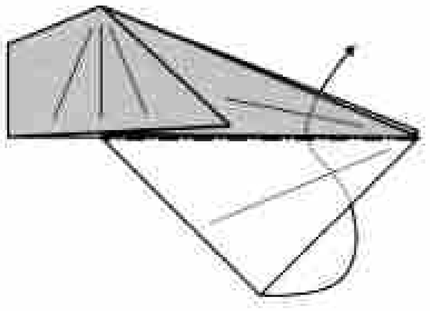
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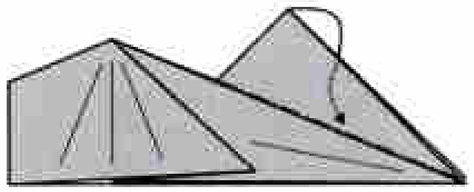
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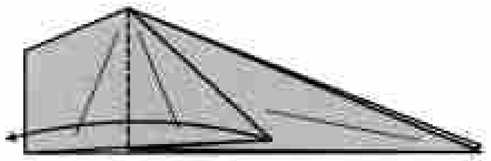
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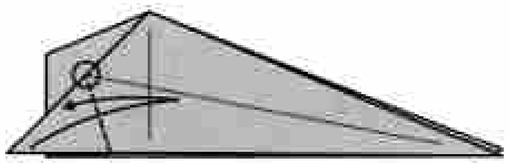
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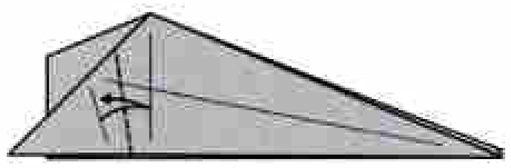
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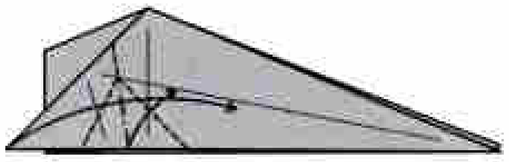
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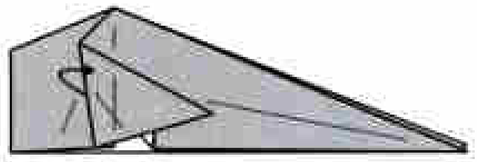
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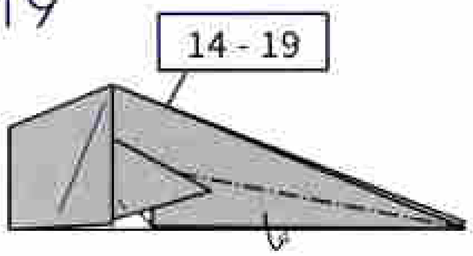
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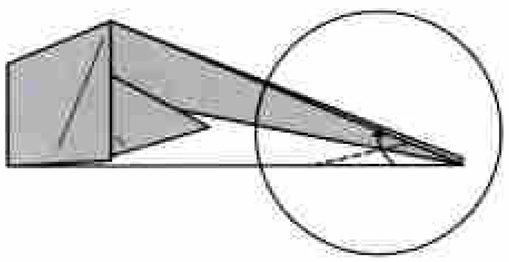
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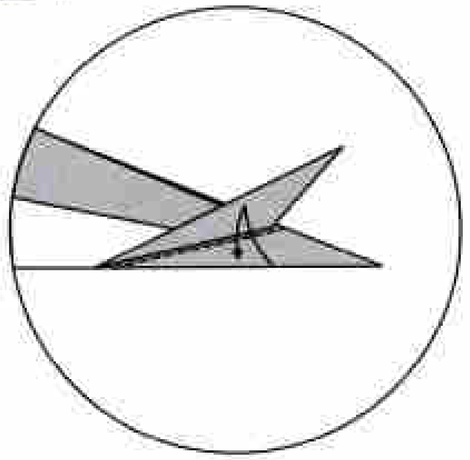
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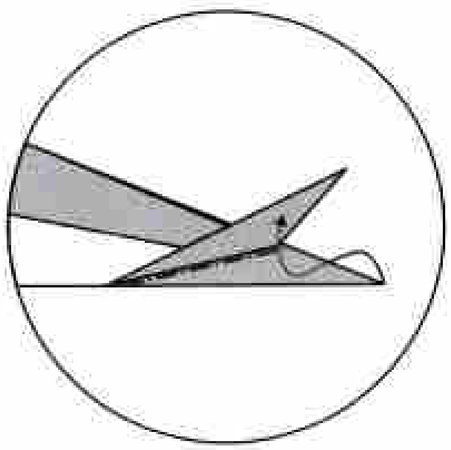
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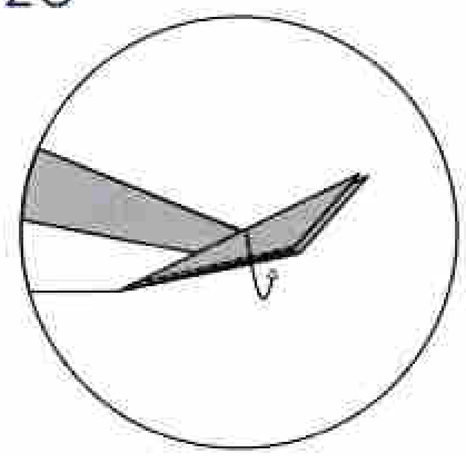
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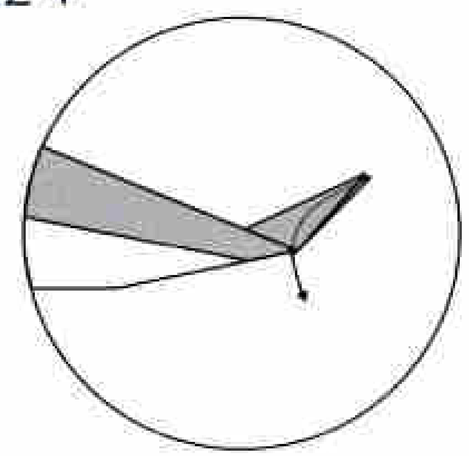
22



23



24



15
Angle bisector.

16
Align creases together.

17
Collapse.

18
Reverse the flap under.

19
Mountain fold. Repeat steps 14 to 19 behind.

20
Valley fold.

23
Mountain fold into other fin.

25
Lift flap. Do not crease.

26
Pull out paper.

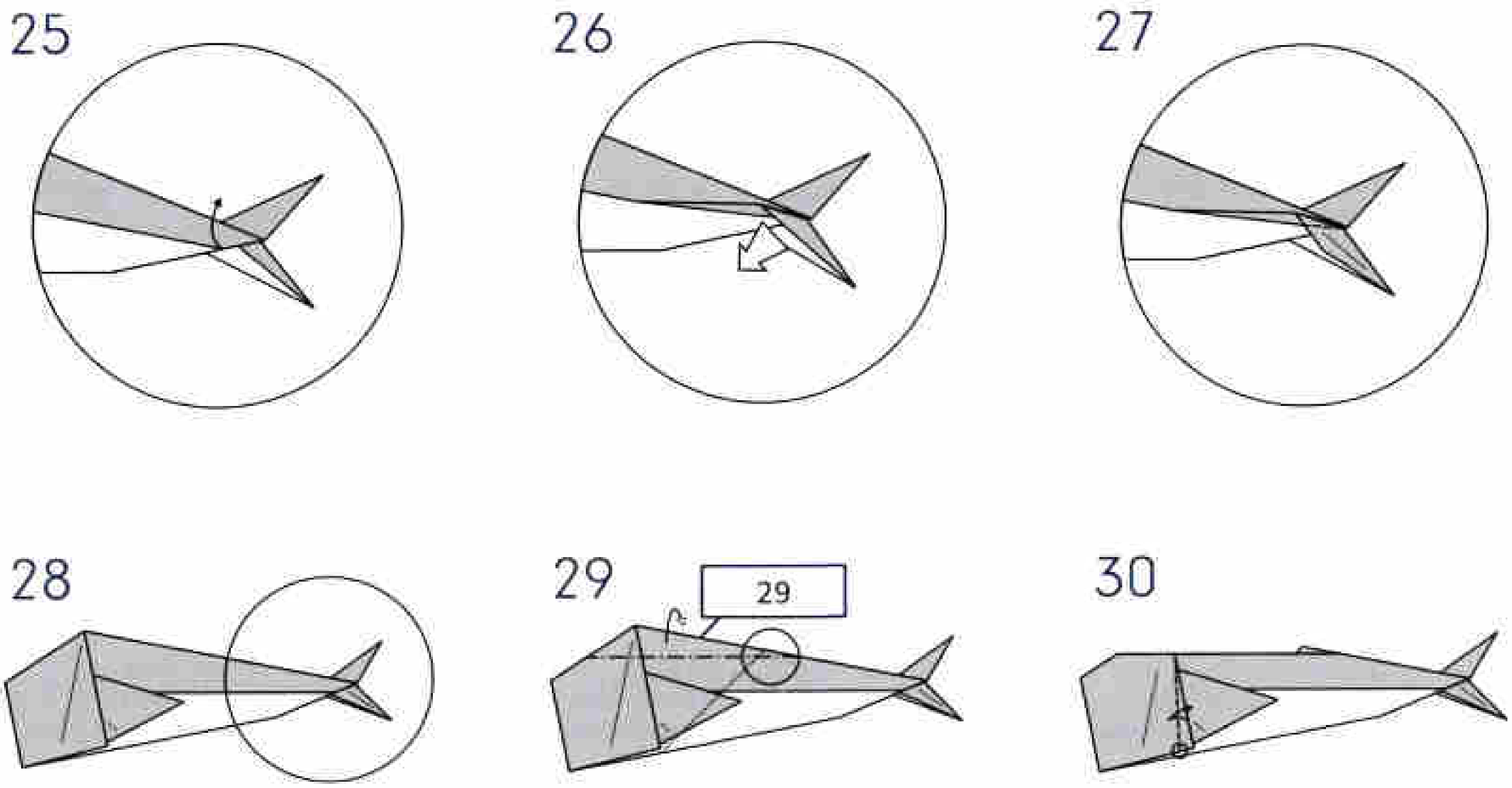
27
Close flap.

29
Mountain fold to expose fin. Repeat behind.

31
Inside reverse fold. Repeat steps 30 and 31 behind.

33
Inside reverse fold.

35
Closed sink.



38
Repeat steps 36 to 38 behind.

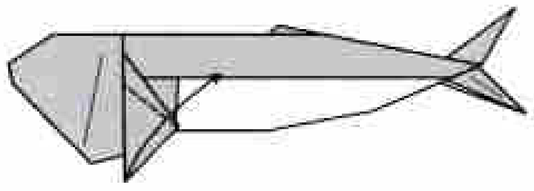
39
Inside reverse fold. Repeat behind.

40
Mountain fold. Repeat behind.

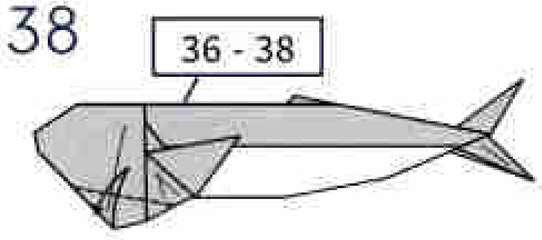
41
Mountain fold. Repeat behind.

42
Horse mackerel completed.

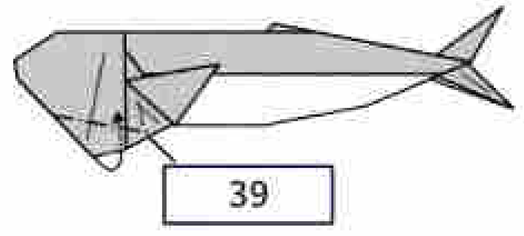
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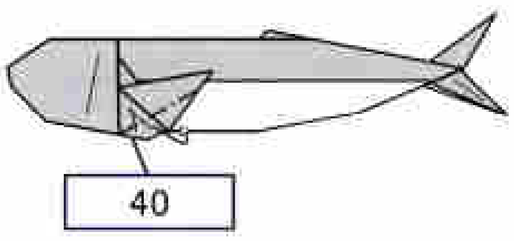
38



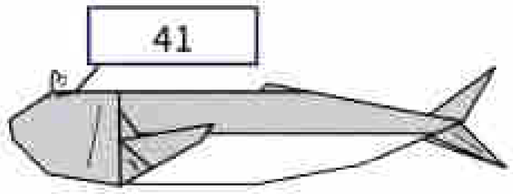
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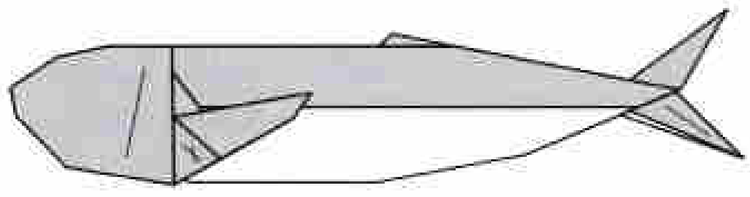
40



41



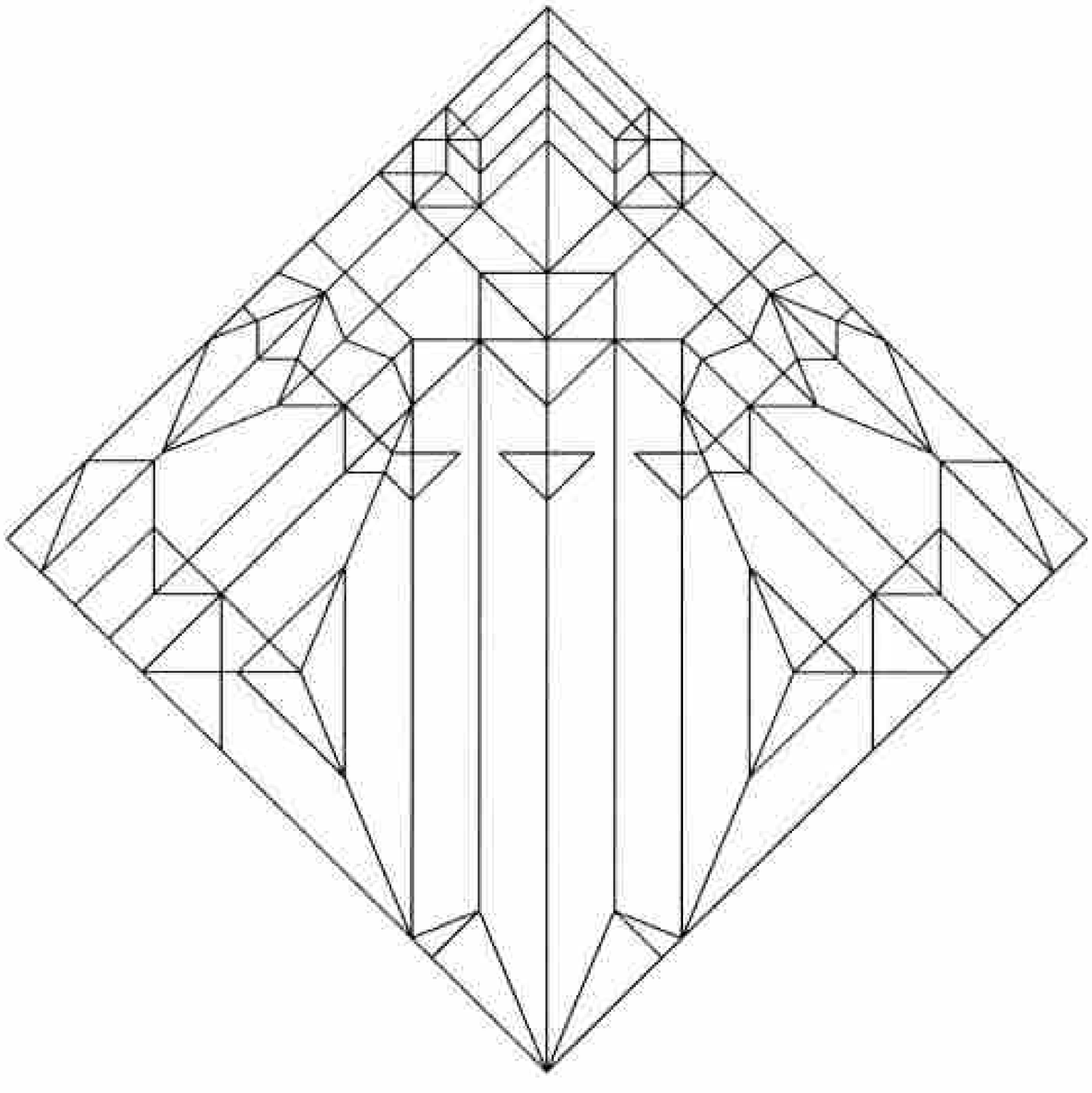
42



Seahorse

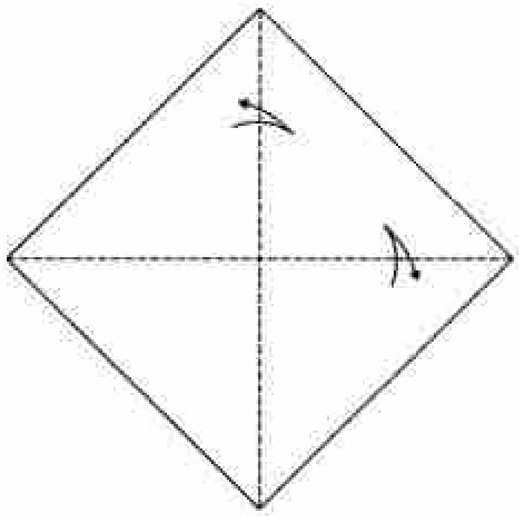
During the creation of the seahorse, I folded the basic head structure first before progressing to the body and down to the tail. I left extra paper in the center of the model to figure out the dorsal fin area after. As long as you distribute enough paper for a specific body part, you can leave it to figure out later. Overall, the design is fairly accurate, though the tail could be slightly longer.

Seahorses are quite unique fish; they swim upright, they are covered with bony armor, and they possess a flexible tail that they use to hold onto seaweed or coral. Unfortunately, like many other species in this book, seahorses have experienced rapid population decline due to various human activities.

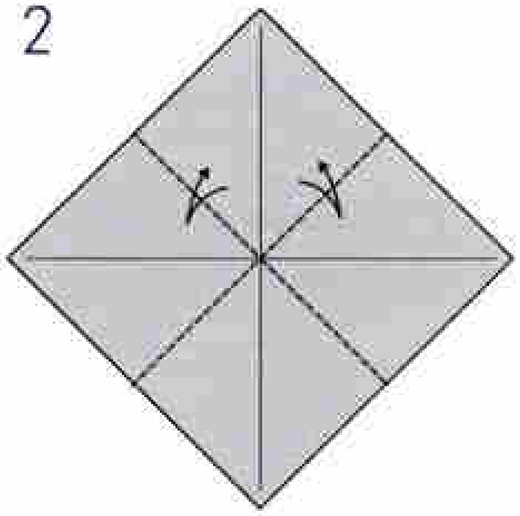




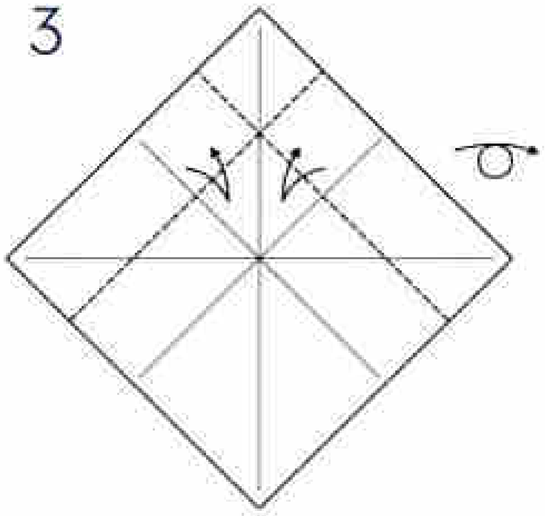
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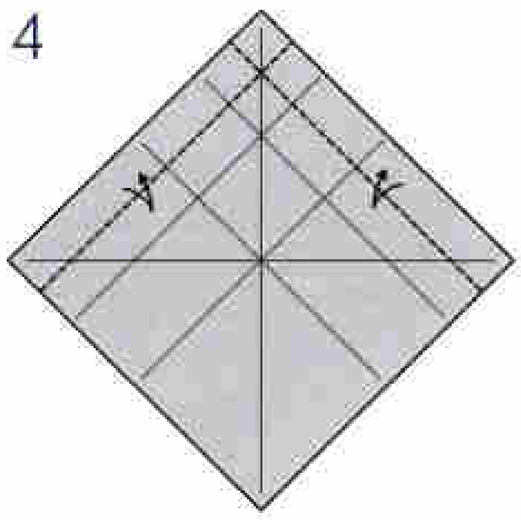
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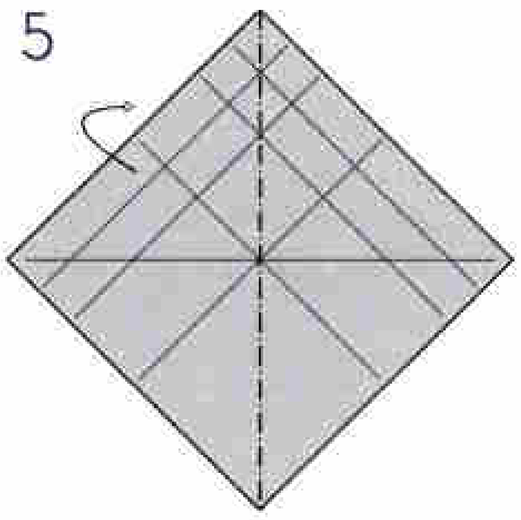
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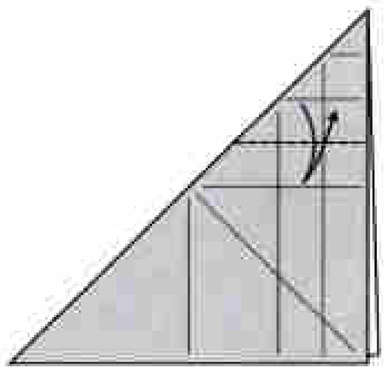
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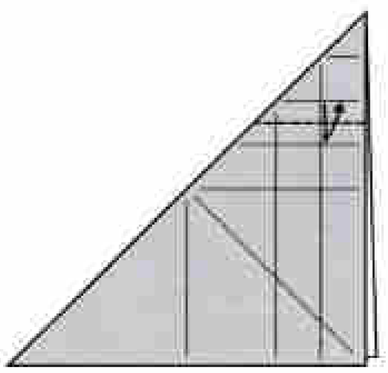
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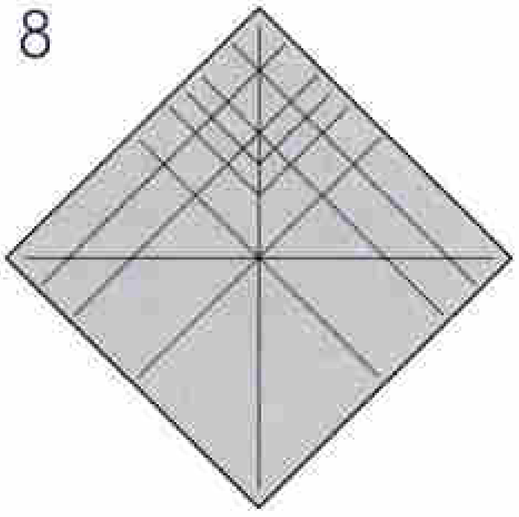
6



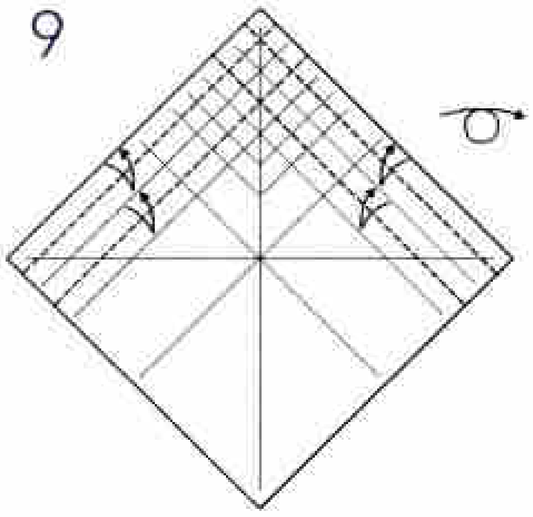
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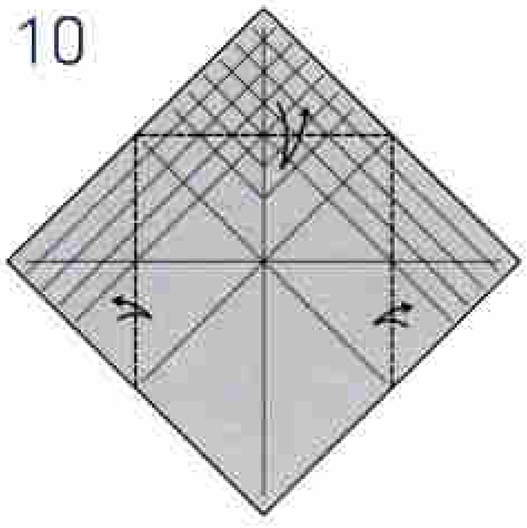
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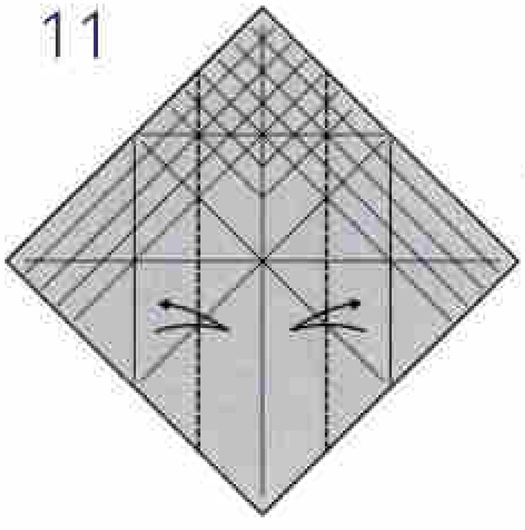
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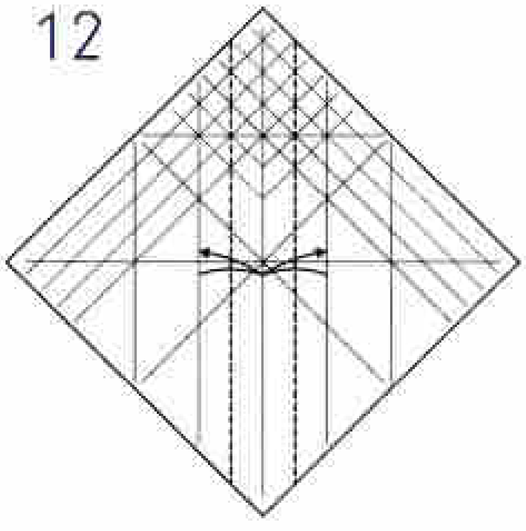
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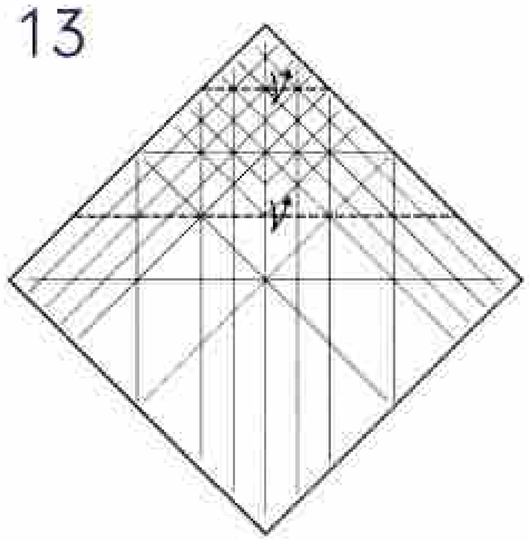
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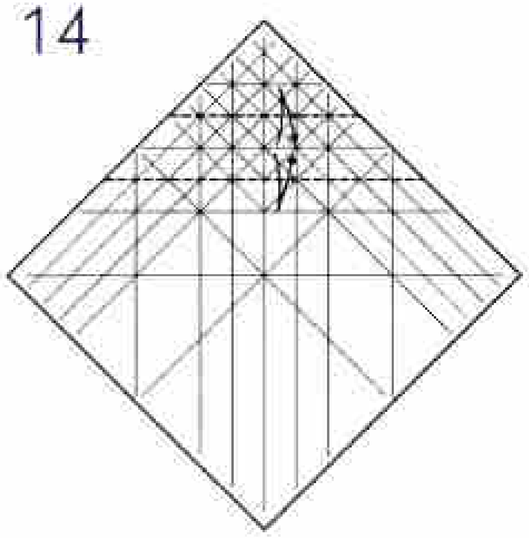
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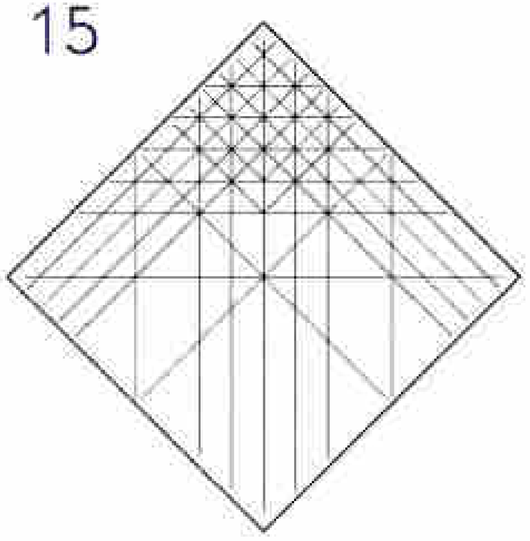
13



14



15

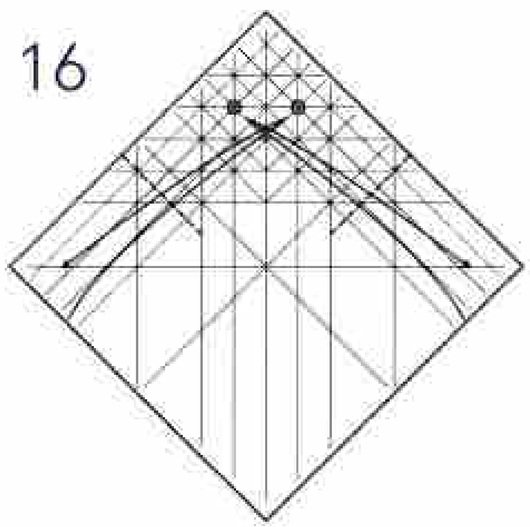


17
Valley folds.

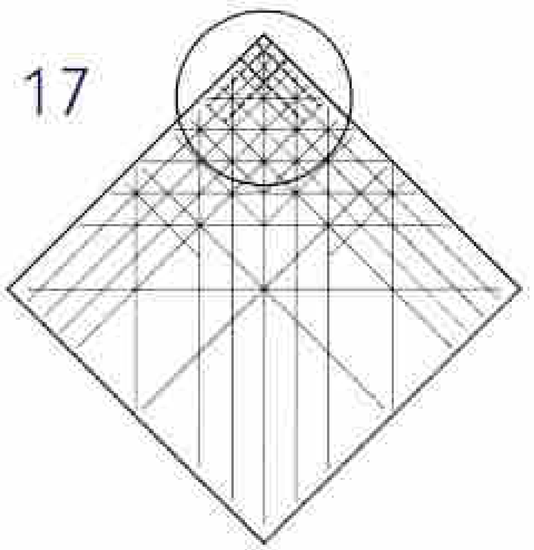
21
Pleat inside.

24
Unsink paper.

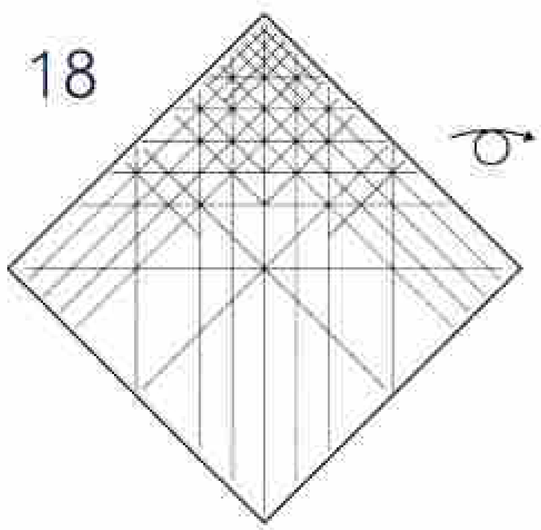
16



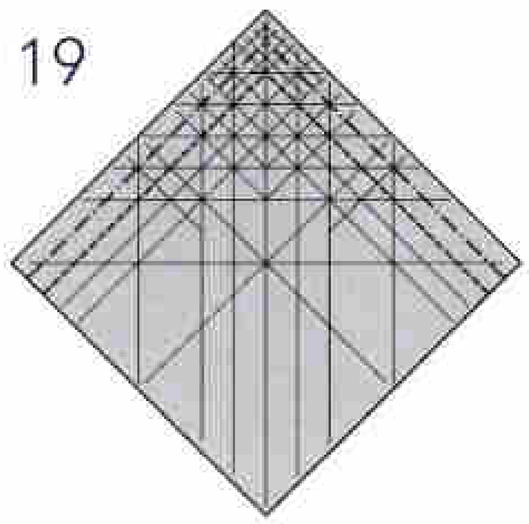
17



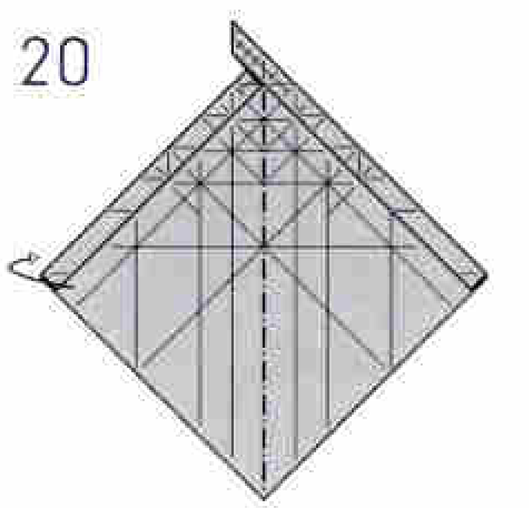
18



19

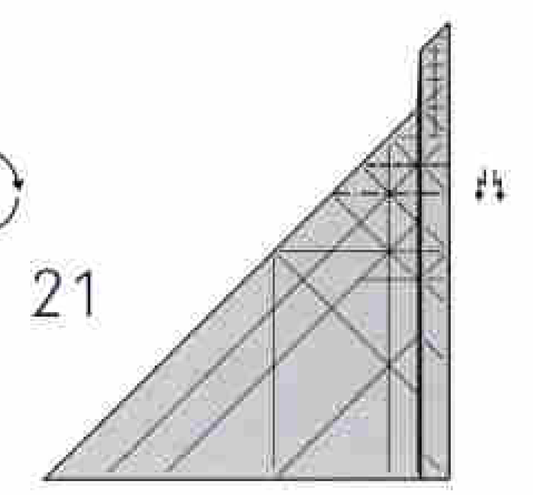


20

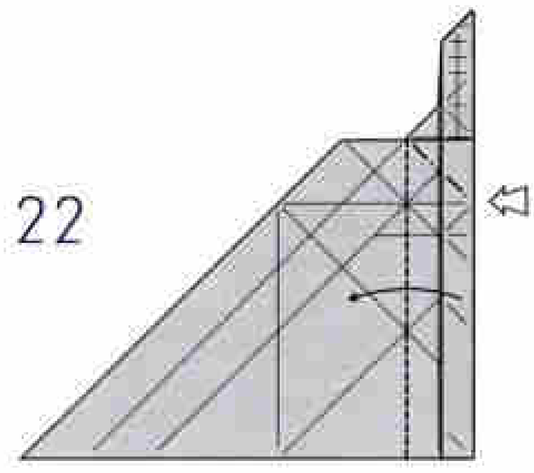


45°

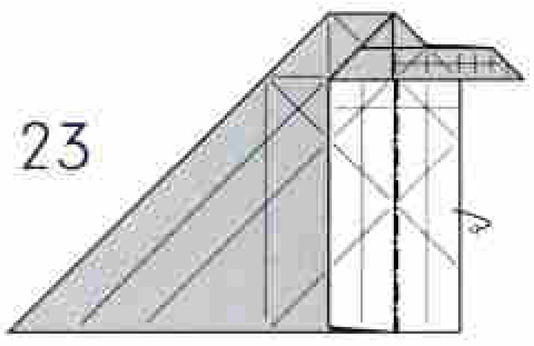
21



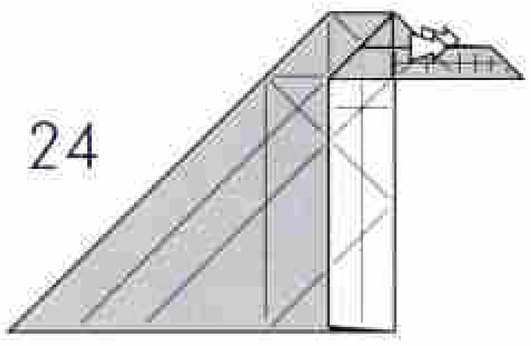
22



23



24



25
Valley fold. Inside reverse at the top. Repeat behind.

26
Open sink.

29
Angle bisector.

30
Angle bisector done. Repeat steps 27 to 29 behind.

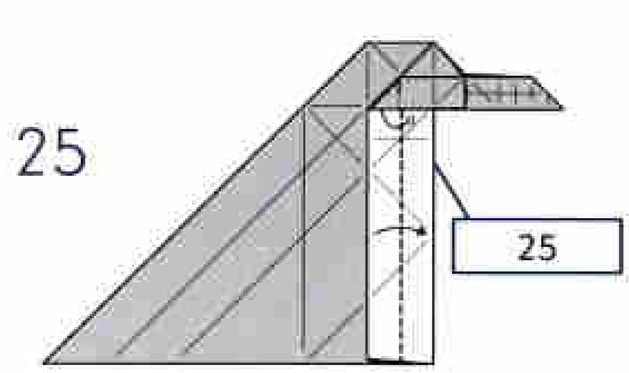
31
Pull out paper by squashing. Repeat behind.

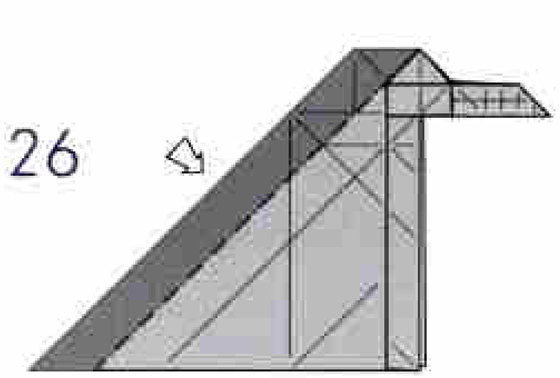
33
Squash. Repeat behind.

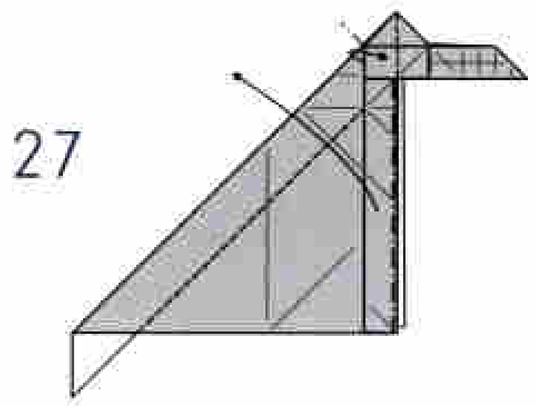
34
Closed sink.

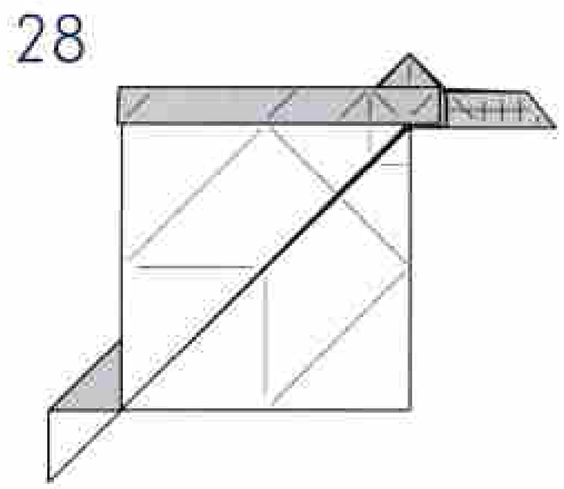
35
Inside reverse fold.

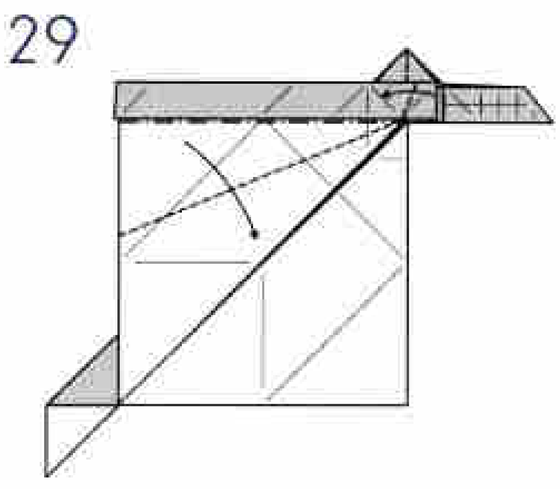
36
Crimp to one side and unfold.

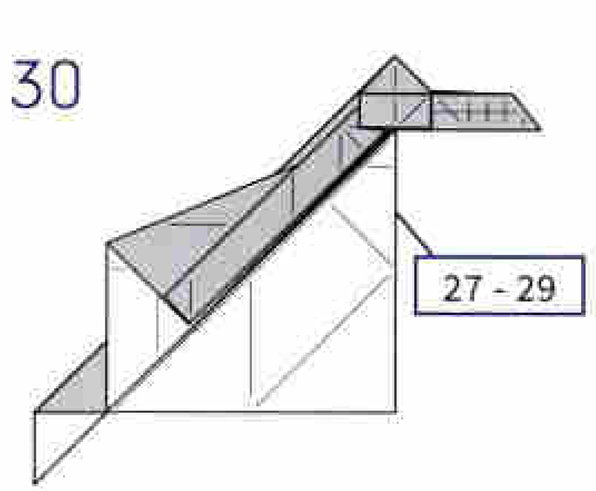


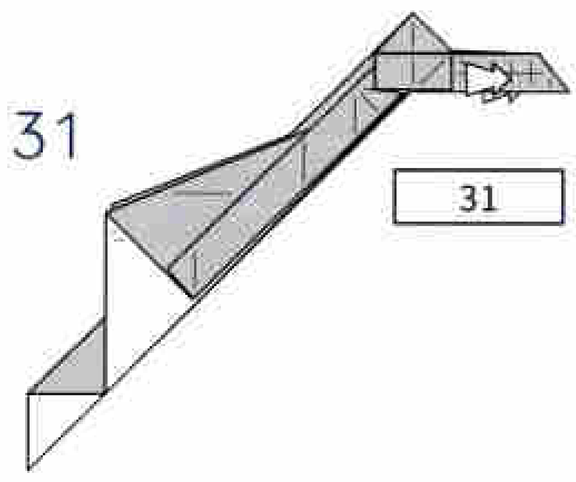


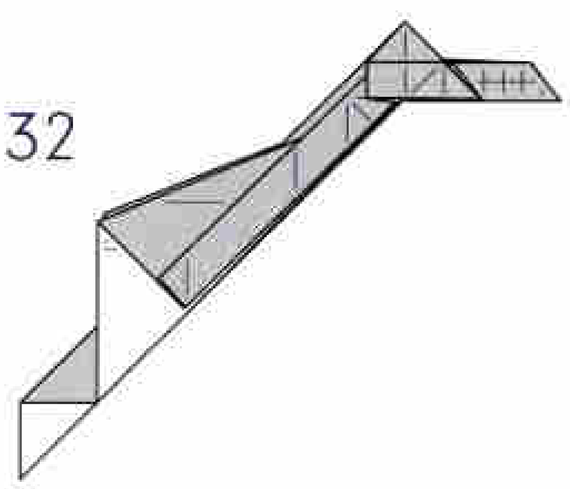


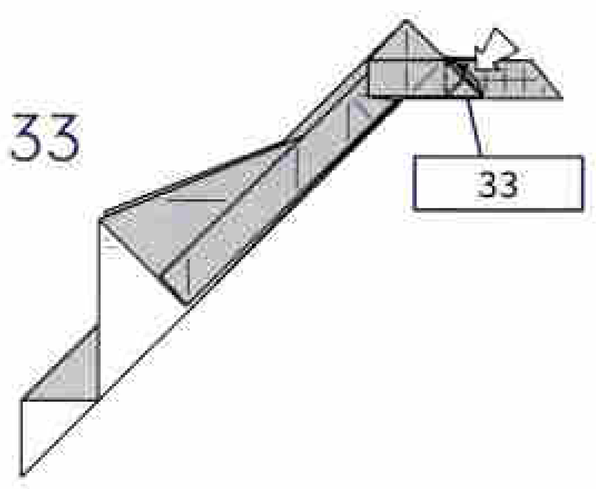


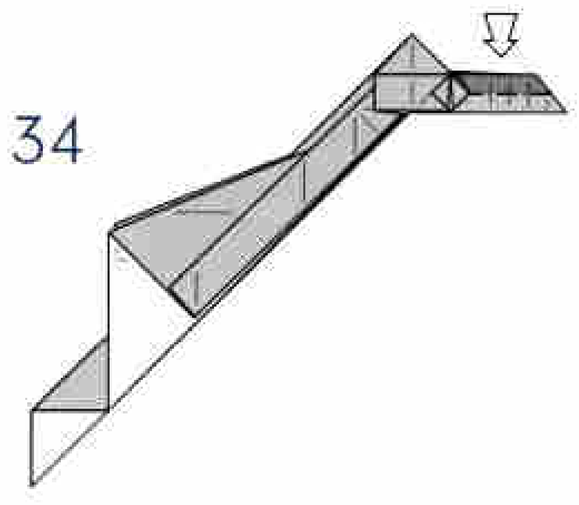


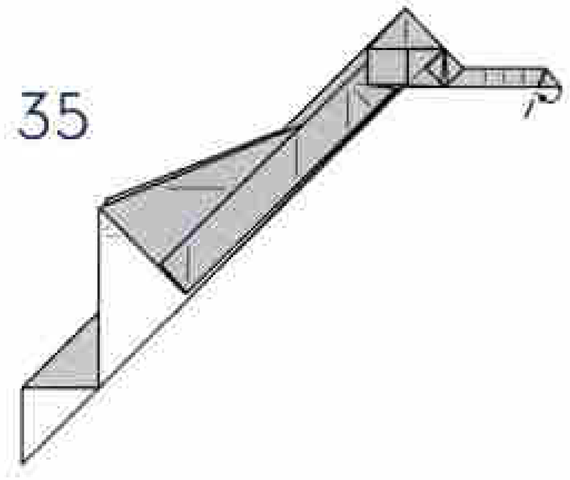


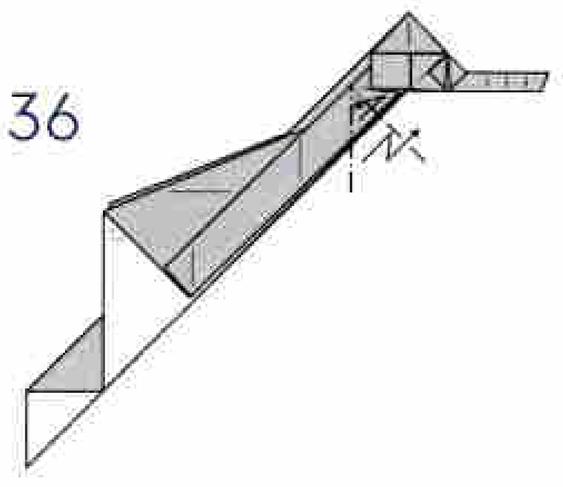




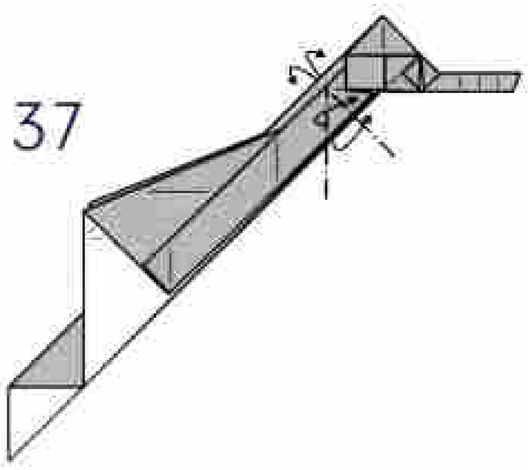




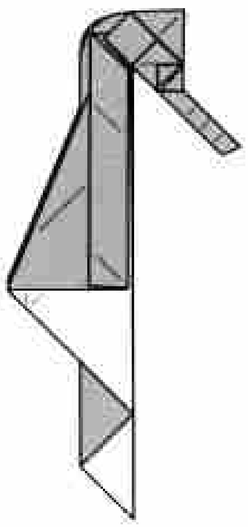




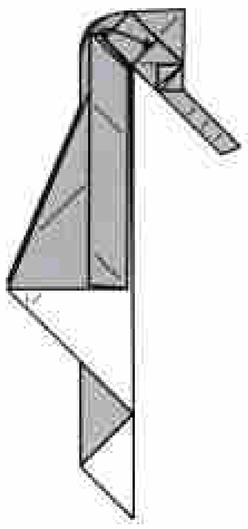
37



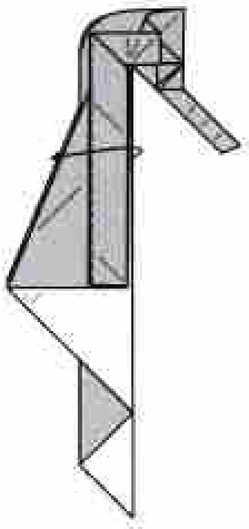
38



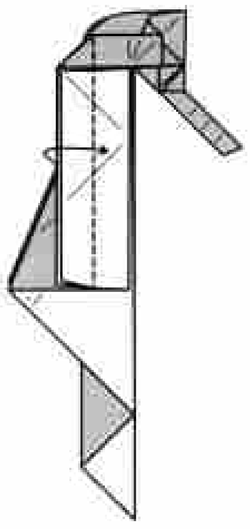
39



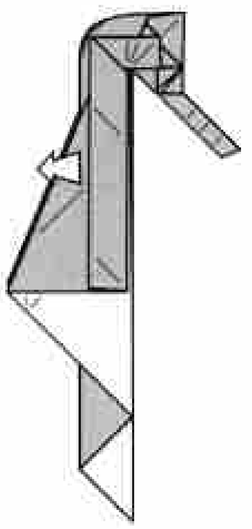
40



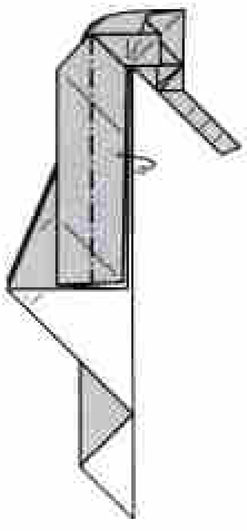
41



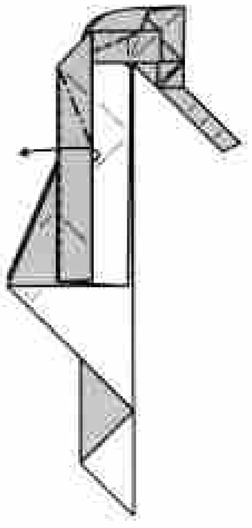
42



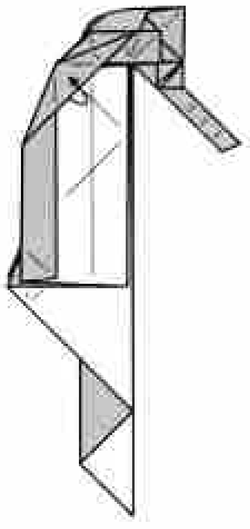
43



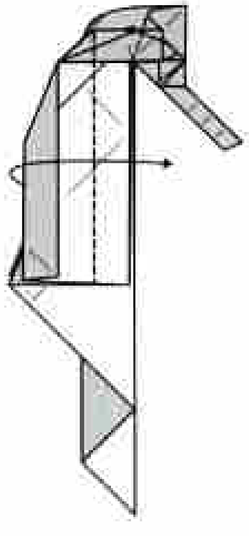
44



45

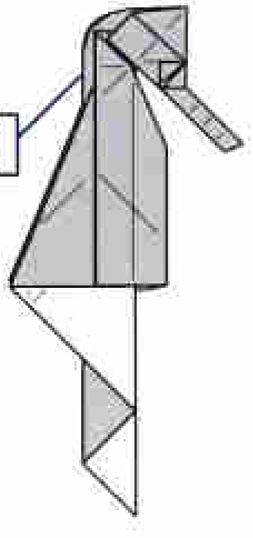


46

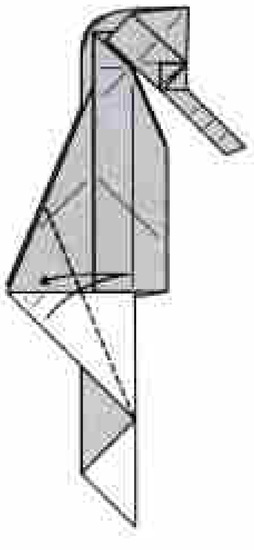


47

39 - 46



48



37
Crimp symmetrically. The back of the neck does not fold flat.

39
Unfold the flap.

42
Unsink.

43
Mountain fold.

45
Reverse the flap to the front.

46
Valley fold the body flap and back of head.

47
Repeat steps 39 to 46 behind.

49
Rabbit ear fold.

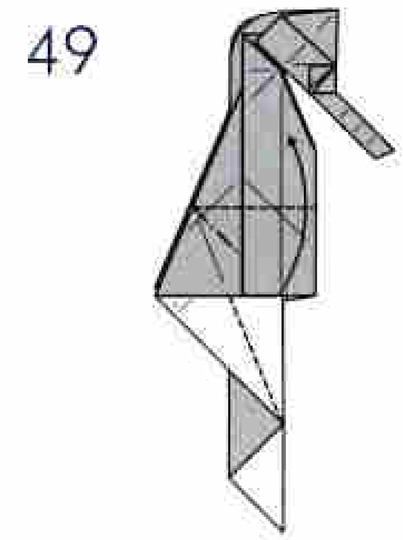
51
Open sink.

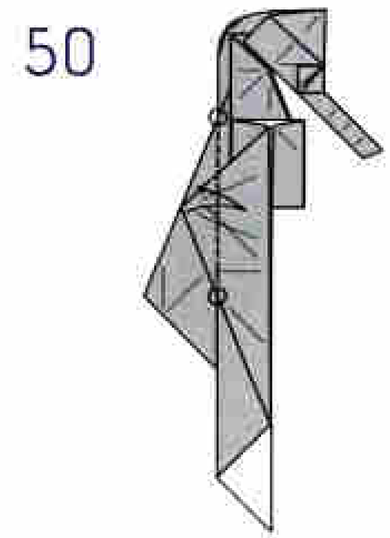
52
Repeat steps 48 to 51 behind.

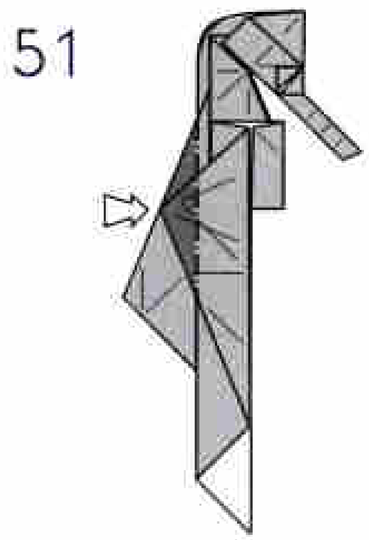
54
Reverse fold.

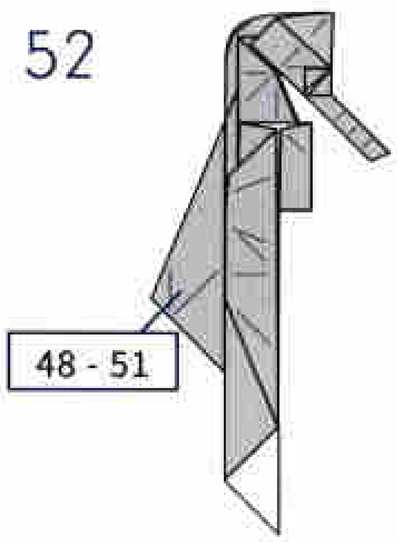
58
Fold and unfold.

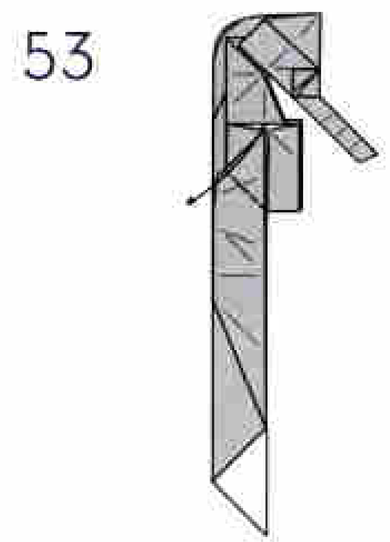
59
Sink.

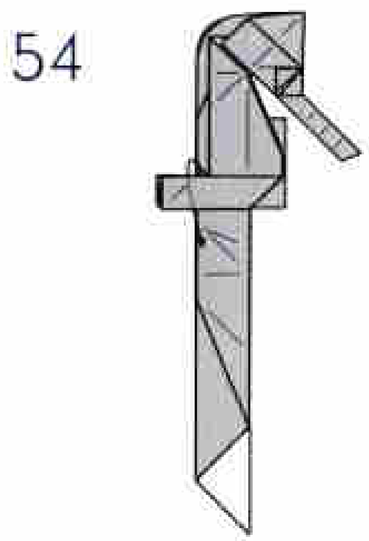


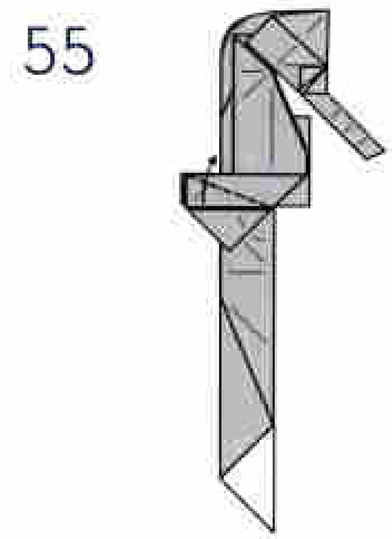


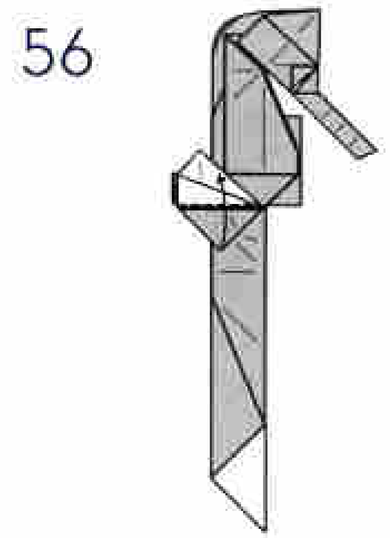


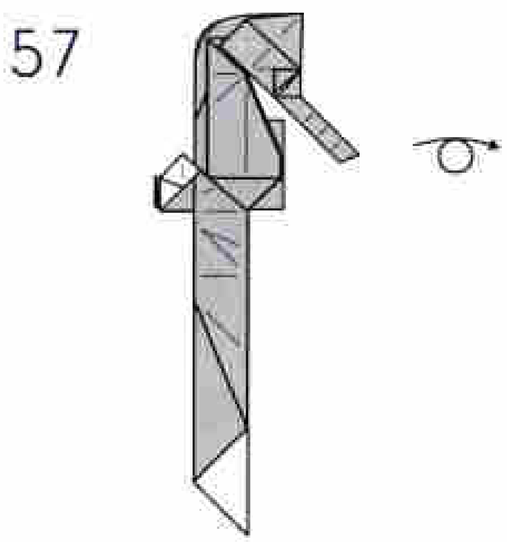


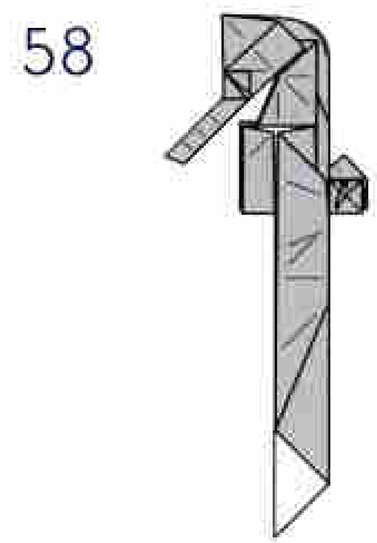


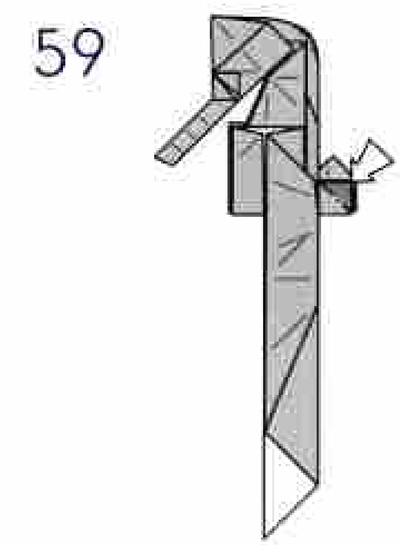


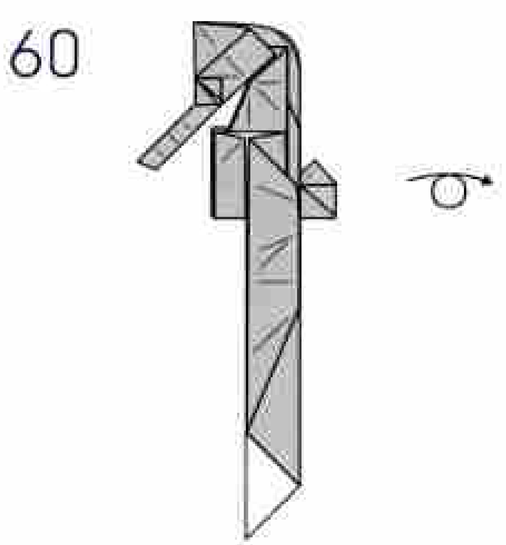




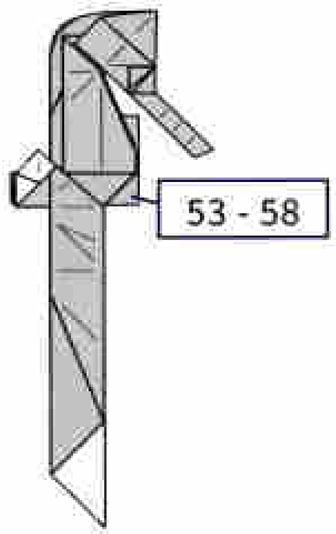




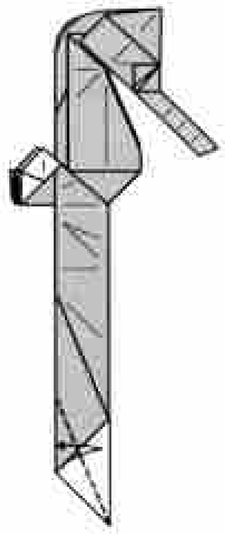




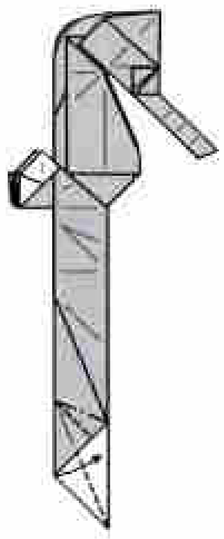
61



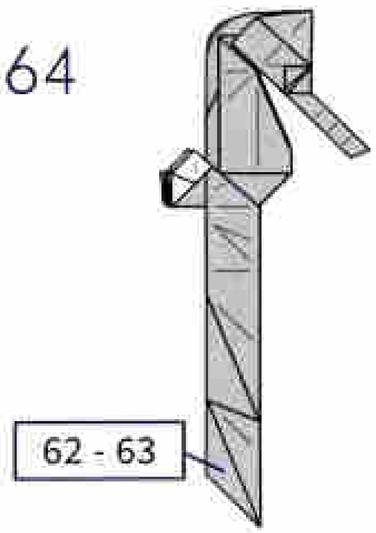
62



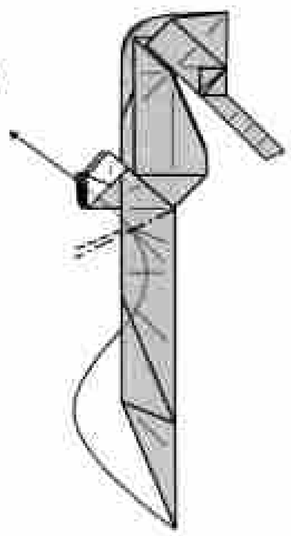
63



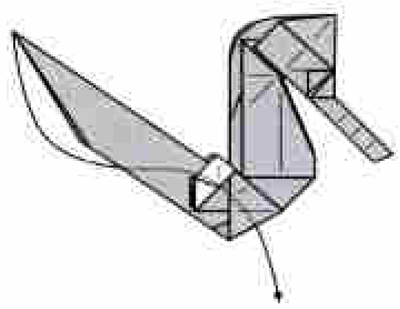
64



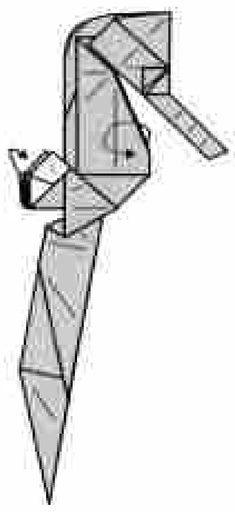
65



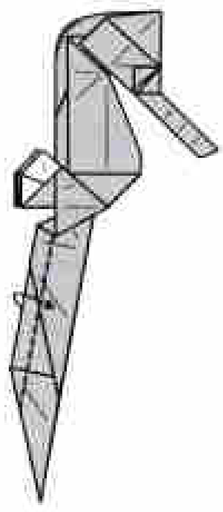
66



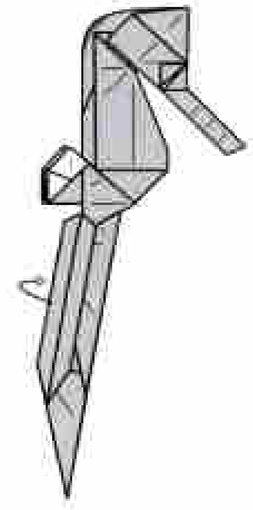
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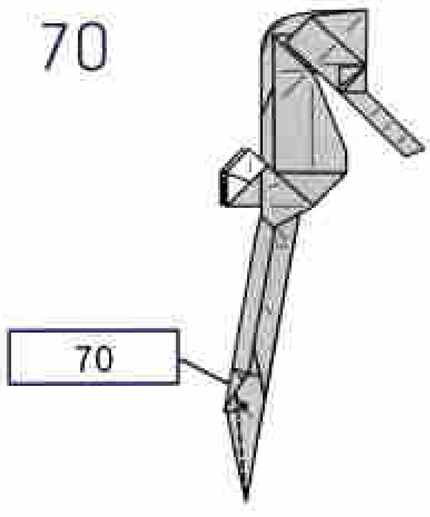
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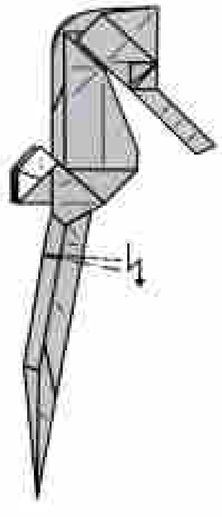
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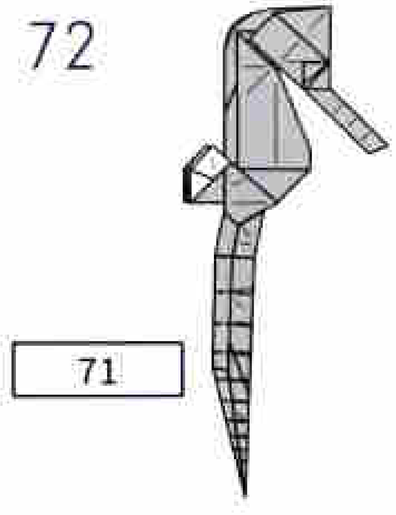
70



71



72



61
Only repeat steps 53 to 58 behind.

64
Repeat steps 62 and 63 behind.

65
Insert belly flap into pocket. Insert inner tail flap into pocket.

67
Inside reverse fold.

70
Rabbit ear. Repeat behind.

71
Crimp.

72
Repeat crimps along the tail.

74
Crimp.

75
Mountain fold
corner.

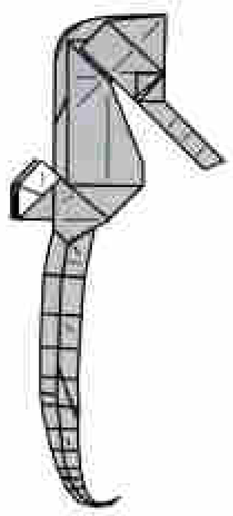
76
Mountain fold.
Repeat behind.

78
Crimp.

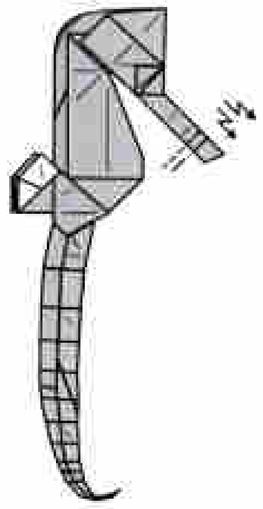
79
Shape the eyes.

80
Seahorse
completed.

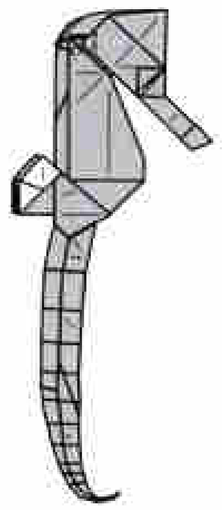
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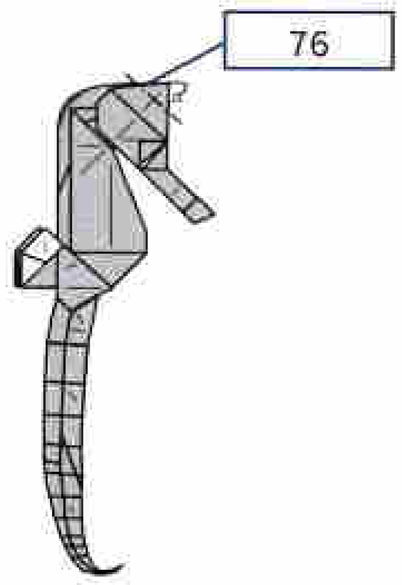
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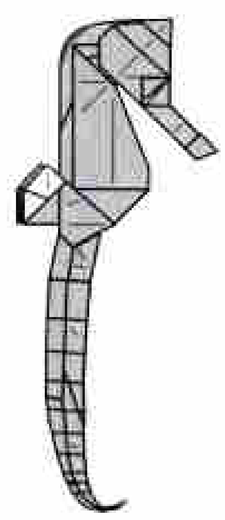
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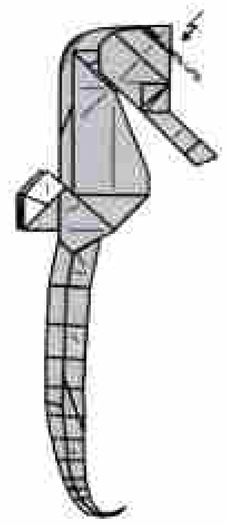
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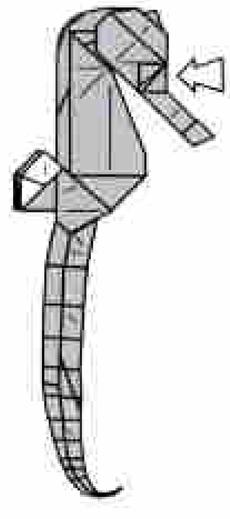
77



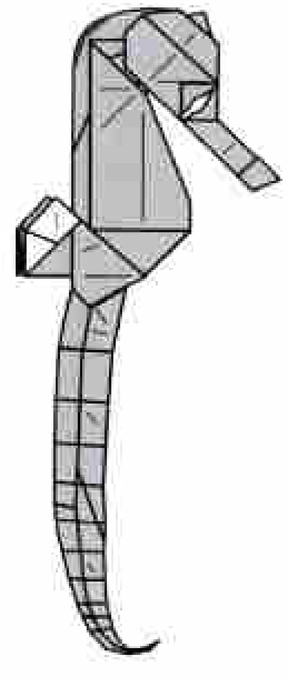
78



79



80



On Shaping

In shaping, the folder gives expression to the model. The collapsed base is the same for every folder, while shaping allows for variation. Shaping details can correct proportions, add textures, and express movement, among numerous other things. The visual appearance of the model is highly dependent on these details.

Shaping requires careful attention to detail. Each shaping detail, whether it is a mountain fold on a corner or a crimp on a limb, has a specific purpose. For example, the fold above the bull shark's gills ends before the nose in order to give definition to the eye. The mountain folds above the head of the giant sea bass form an obtuse angle in order to emphasize the fish's largeness. In addition, the octopus' third right tentacle is curled which indicates that it is male.

Sometimes shaping is the signature feature of the origami piece. Take for example, the green sea turtle hatchling and the cuttlefish: the former includes a sequence that expands the otherwise two-dimensional base into a three-dimensional model, while the latter utilizes a gift-wrapping procedure to form the closed body of the cephalopod.

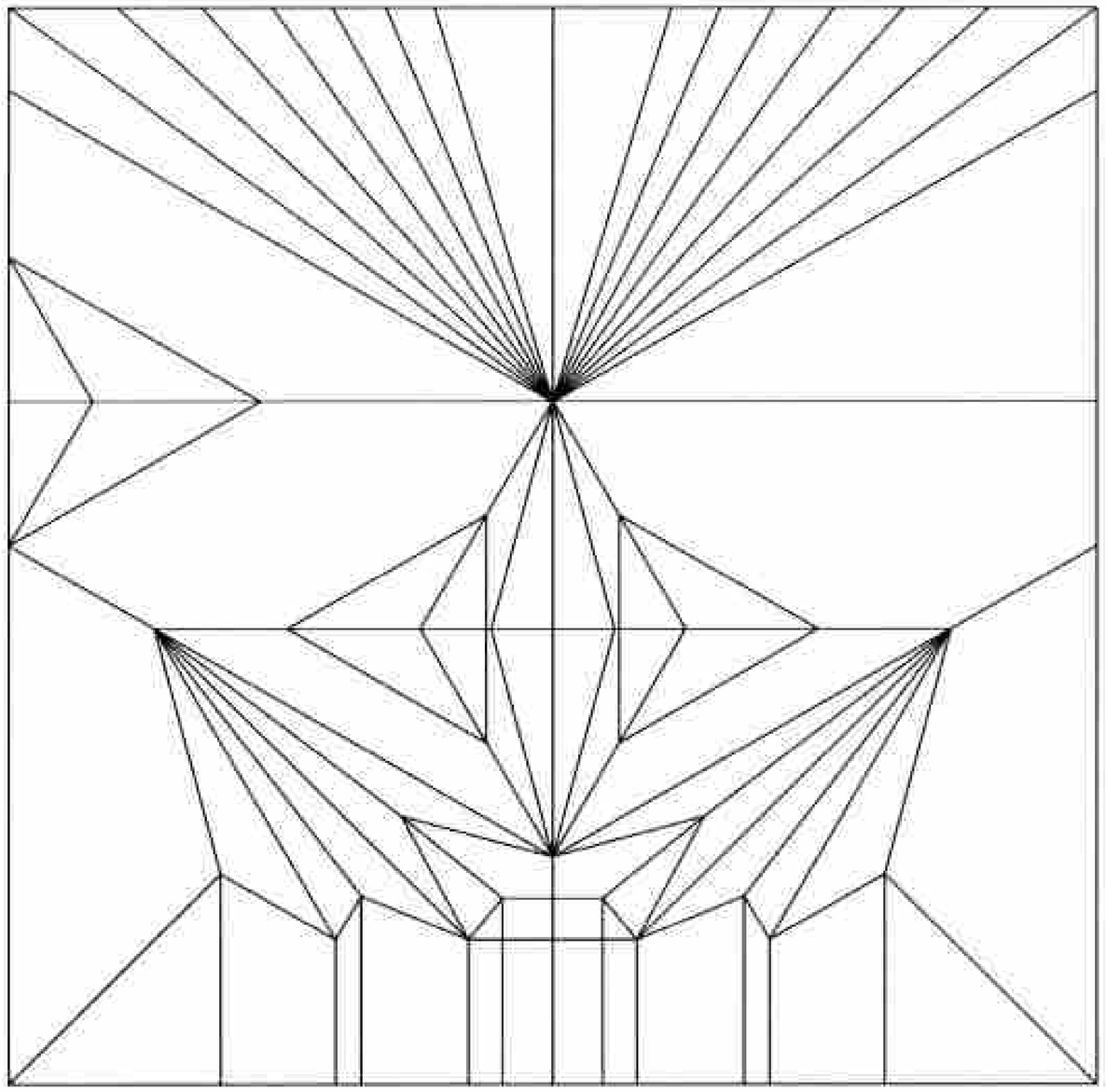
During the iterative design process, test various shaping possibilities and compare. Fold the same base multiple times, shaping each base differently. When I refold models, I often discover improved ways to shape certain parts. Try to decide on all shaping details on a practice model, so you won't have to risk making changes on the final model. It is also possible to over-shape a model by adding unnecessary details. Sometimes the best way to shape a feature is to keep it simple.

Shaping should be finished with glue, so all the shaping details are made permanent.

Tuna

The tuna is a difficult model to design because it has long fins that protrude from the torpedo-shaped body. To design this model, I used a crumpling method to distribute the paper into the right amounts for each body part. Then, I smoothed out the unnecessary wrinkles. After I figured out what creases I needed in their general areas, I had to determine the appropriate ratios that would best fit the creases. This part required the most time and effort and resulted in unconventional ratios and angles. For the rows of finlets, I used a series of reverse folds to create the jagged structure along the edge of the paper. One part that stands out in this design is the single flat plane that forms the face of the body under the lateral line. Overall, the crumpling design process produced a satisfactory result.

Use one colored paper for this model.





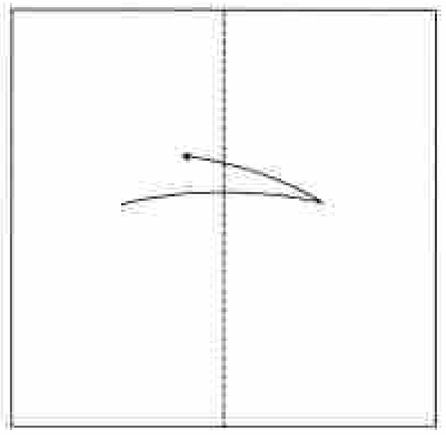
6

Repeat step 4 and 5 on the left side.

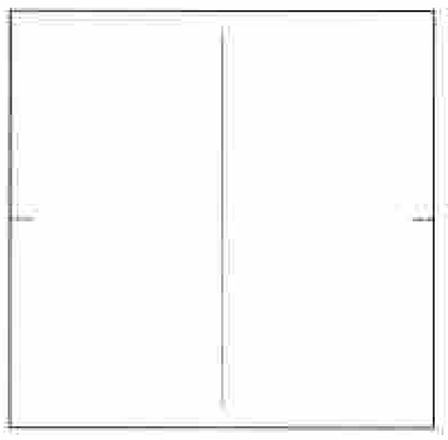
9

Angle bisector. Repeat on the left side.

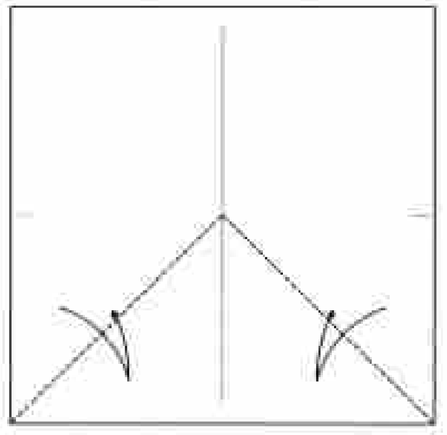
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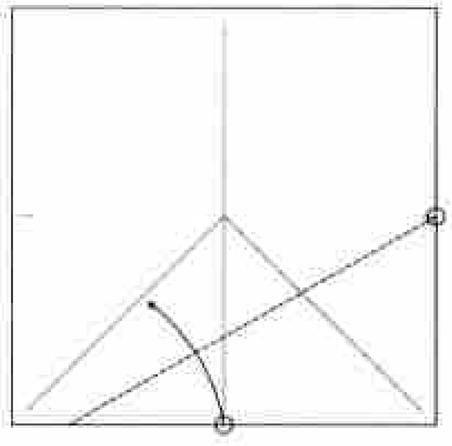
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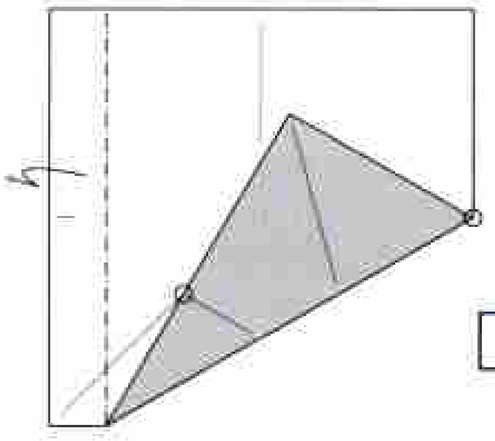
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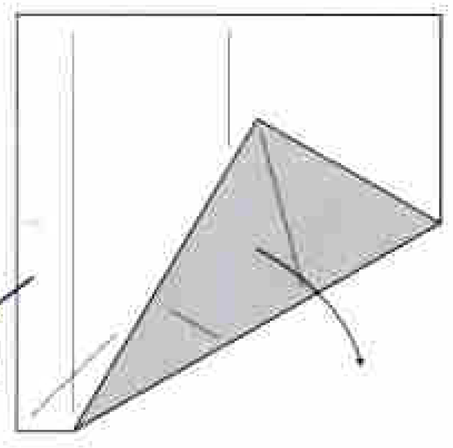
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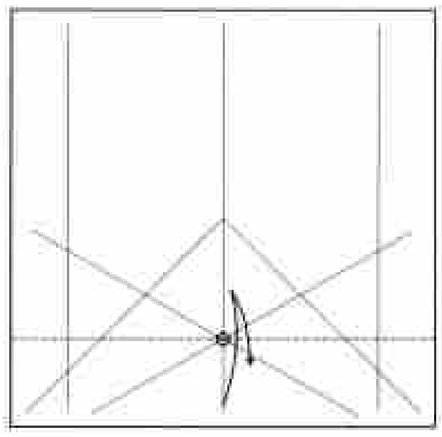
5



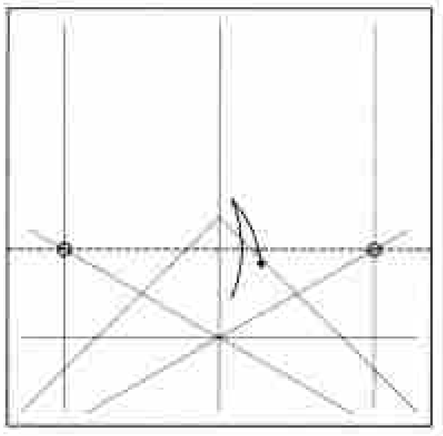
6



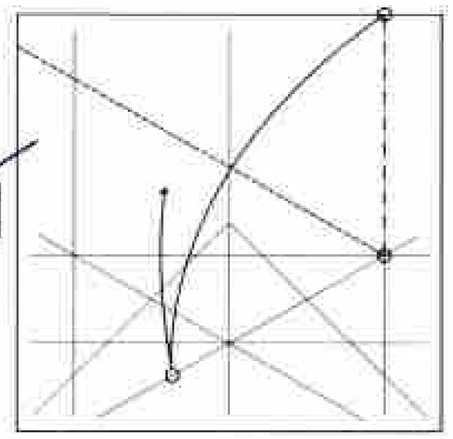
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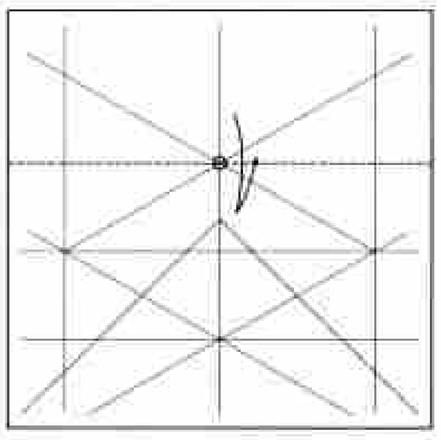
8



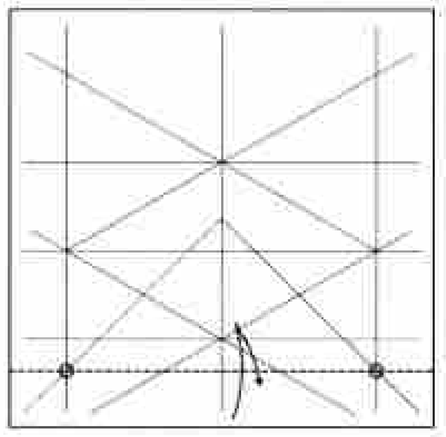
9



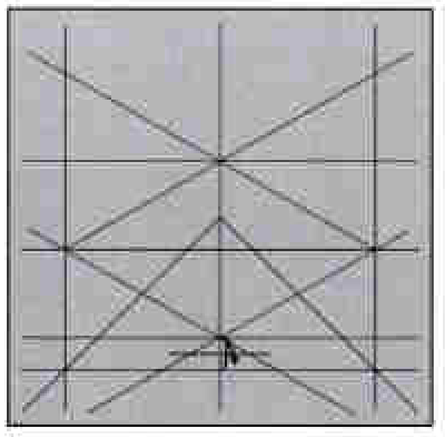
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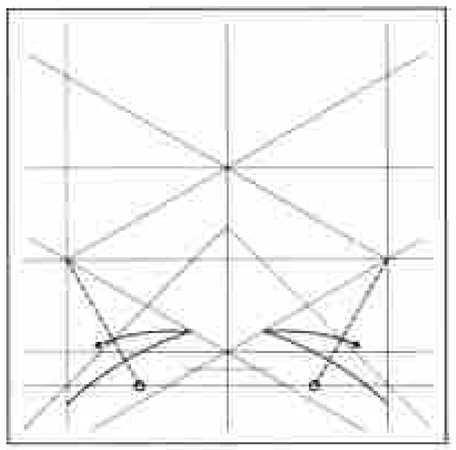
11



12

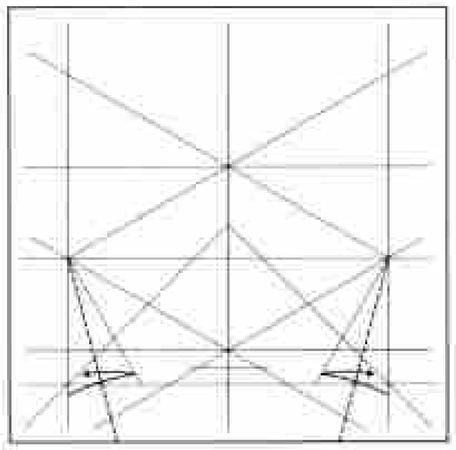


13



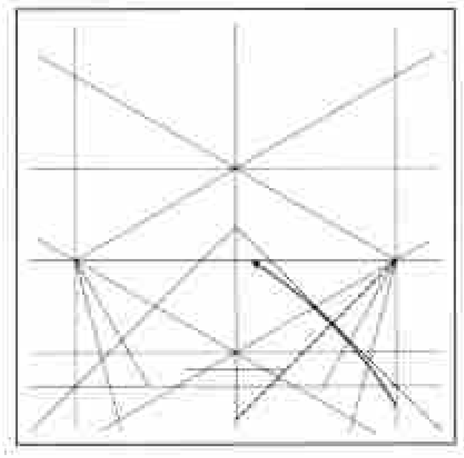
13
Angle bisectors.

14



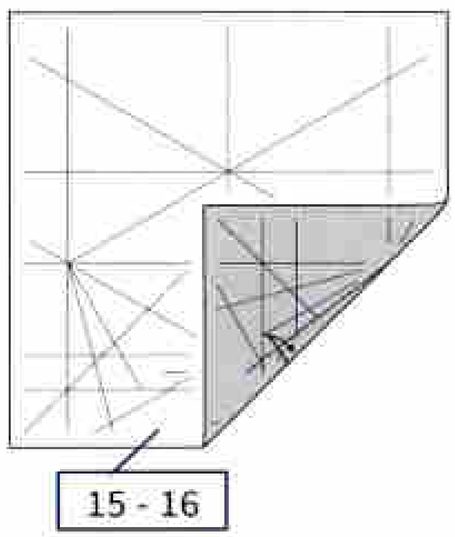
14
Angle bisectors.

15

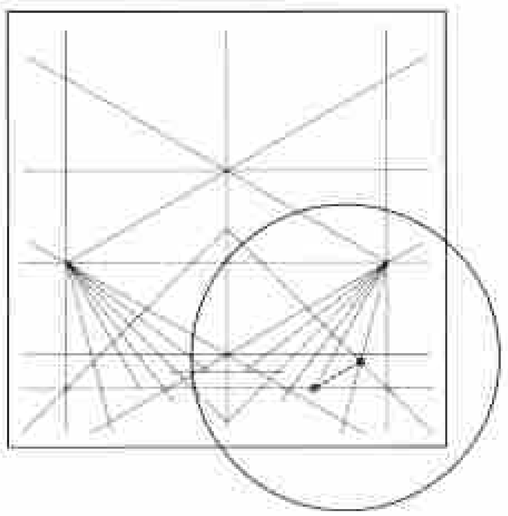


16
Angle bisector. Repeat step 15 and 16 on the left side.

16

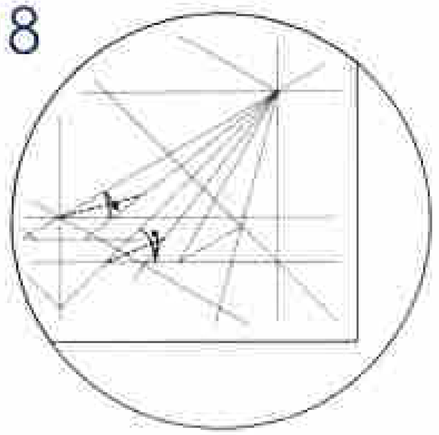


17



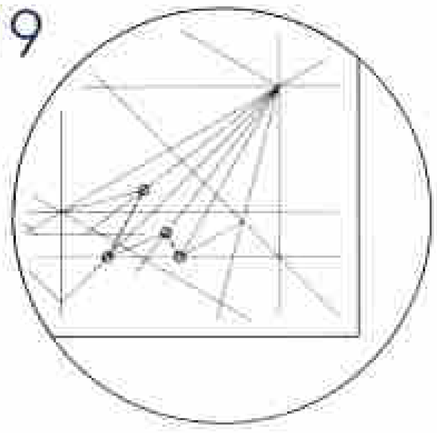
17
Crease between reference points.

18



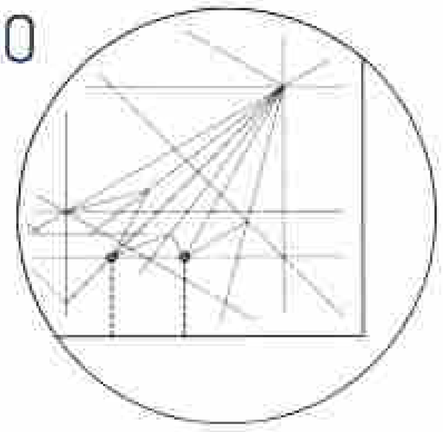
18
Angle bisectors.

19

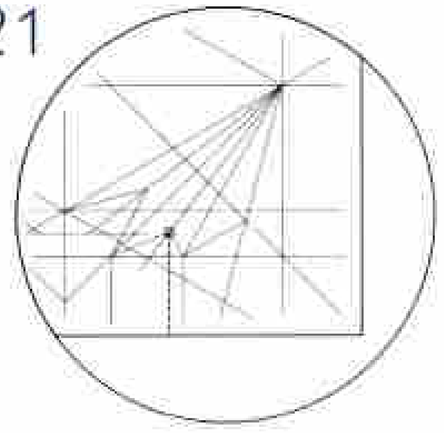


19
Connect reference points.

20

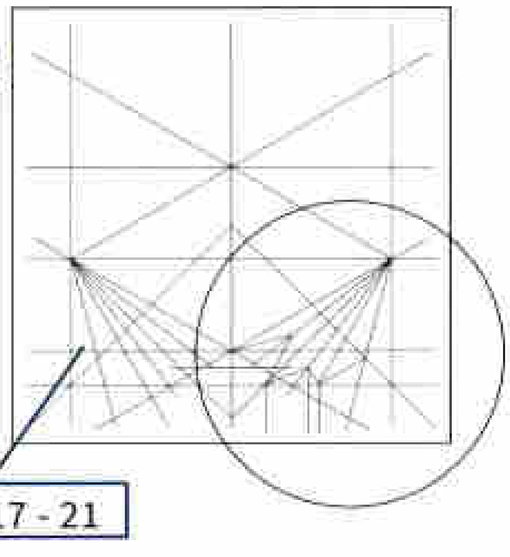


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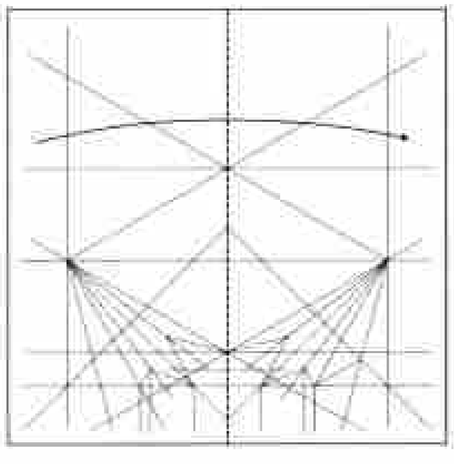


22
Repeat steps 17 to 21 on the left side.

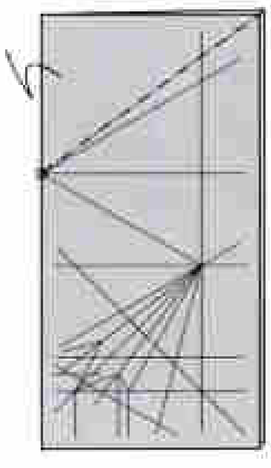
22



23



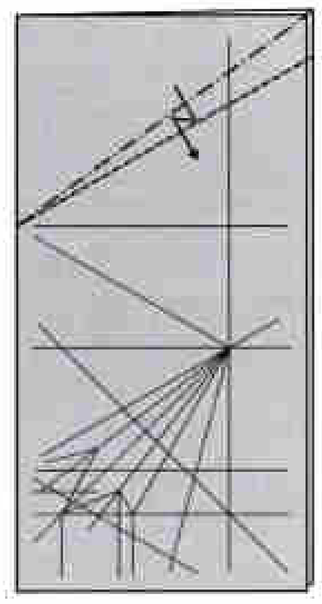
24



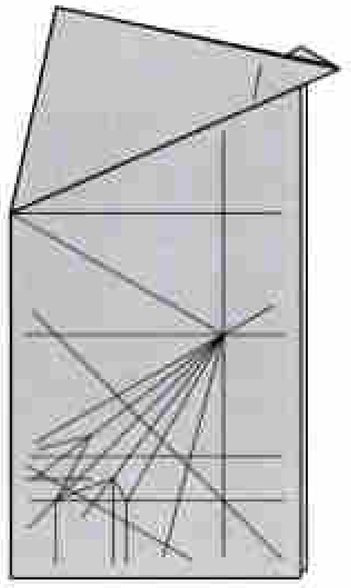
28
Angle bisector
on the last flap.

29
Angle bisector
completed.
Unfold every-
thing.

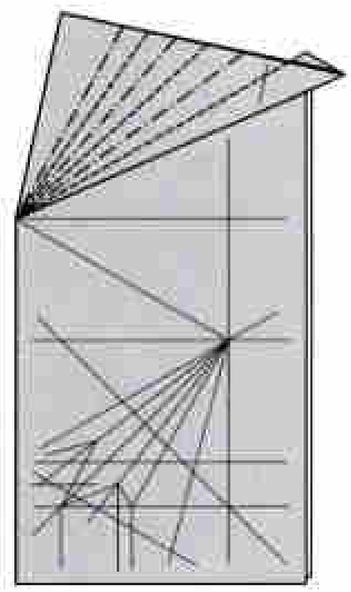
25



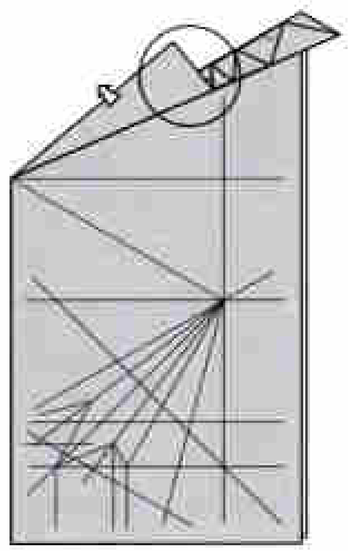
26



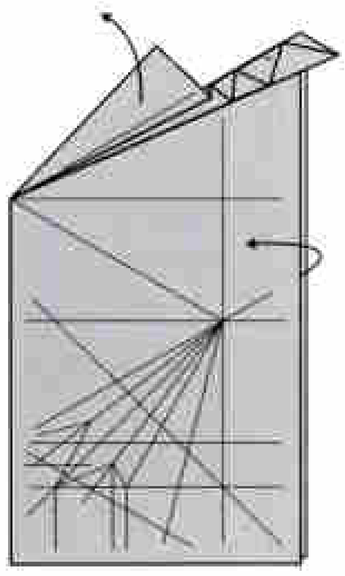
27



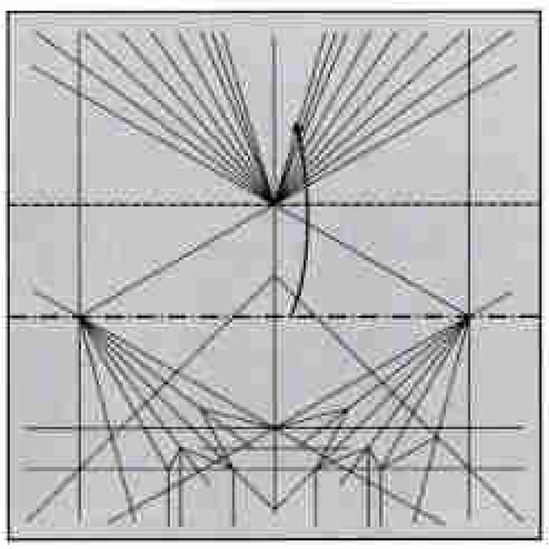
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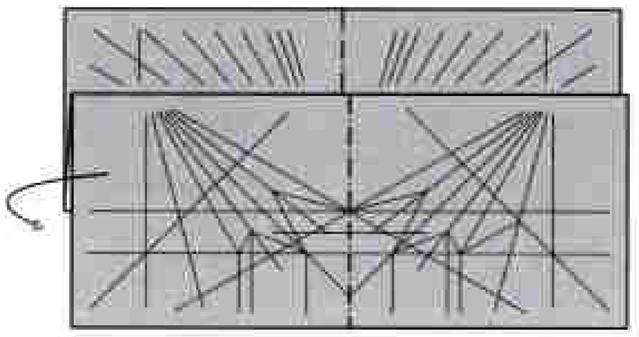
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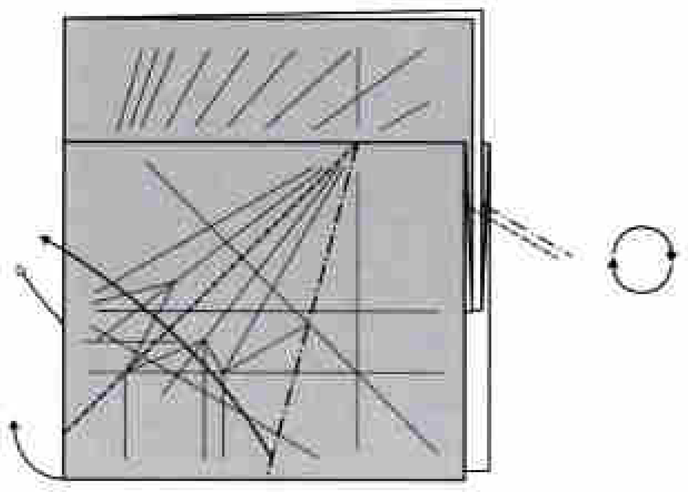
30



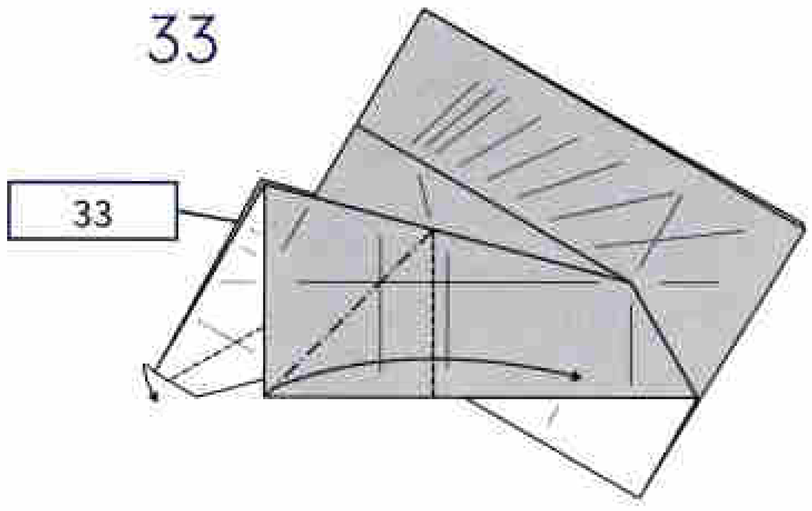
31



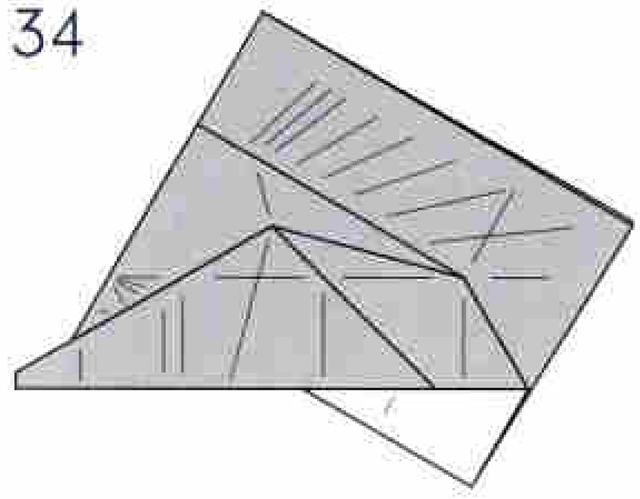
32



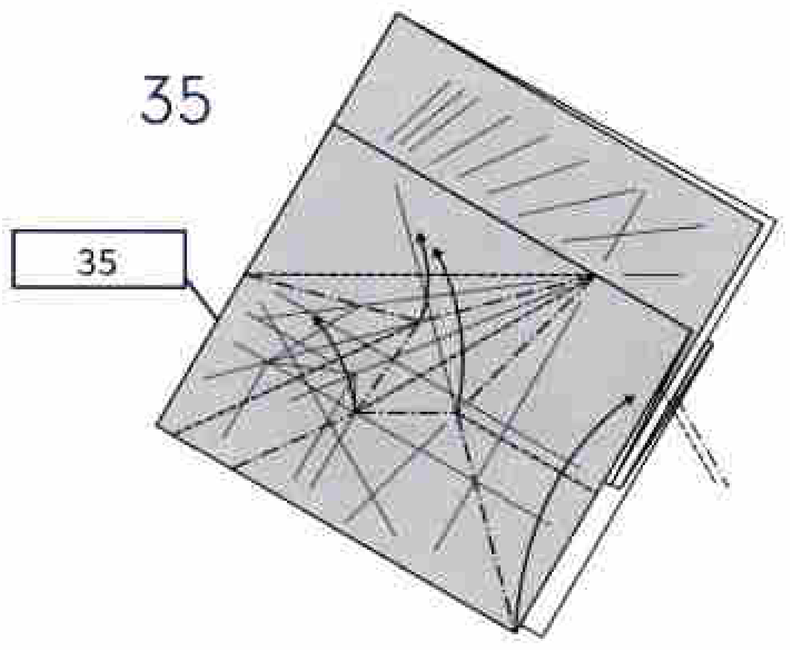
33



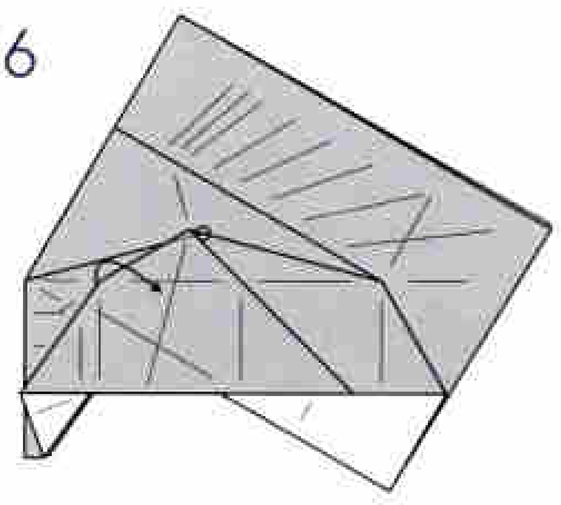
34



35



36



33
Rabbit ear fold. Repeat behind simultaneously.

34
Open to step 32.

35
Collapse along creases as shown. Repeat behind simultaneously.

36
Notice the points do not line up. Open the flap without creasing.

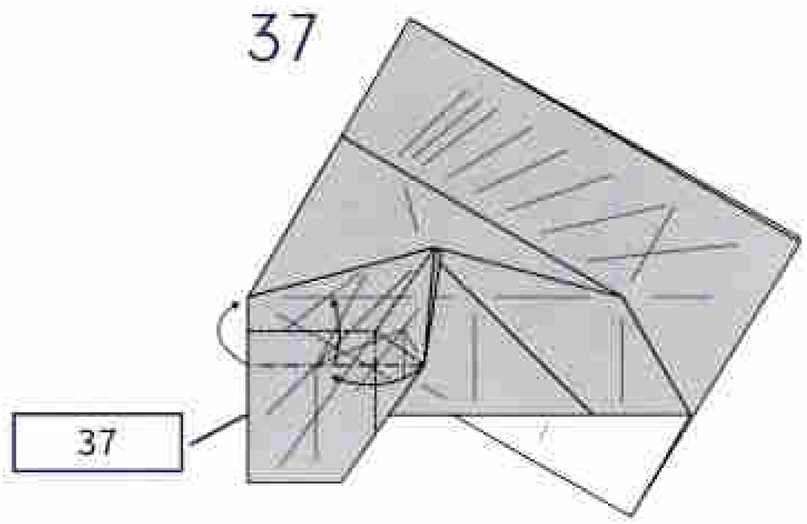
37
Collapse as shown. Repeat behind simultaneously.

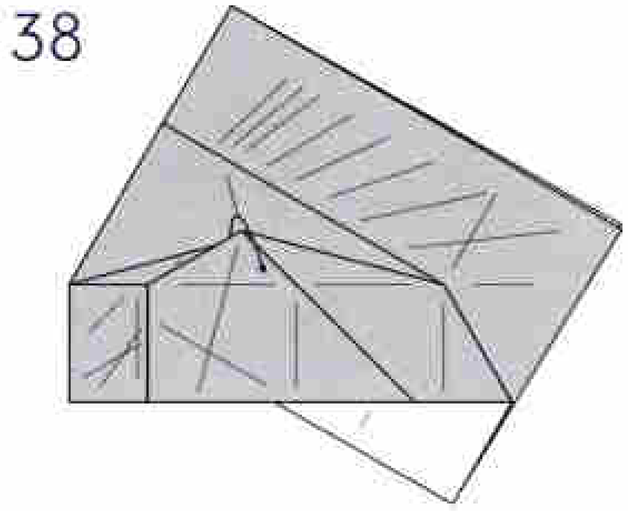
38
Open.

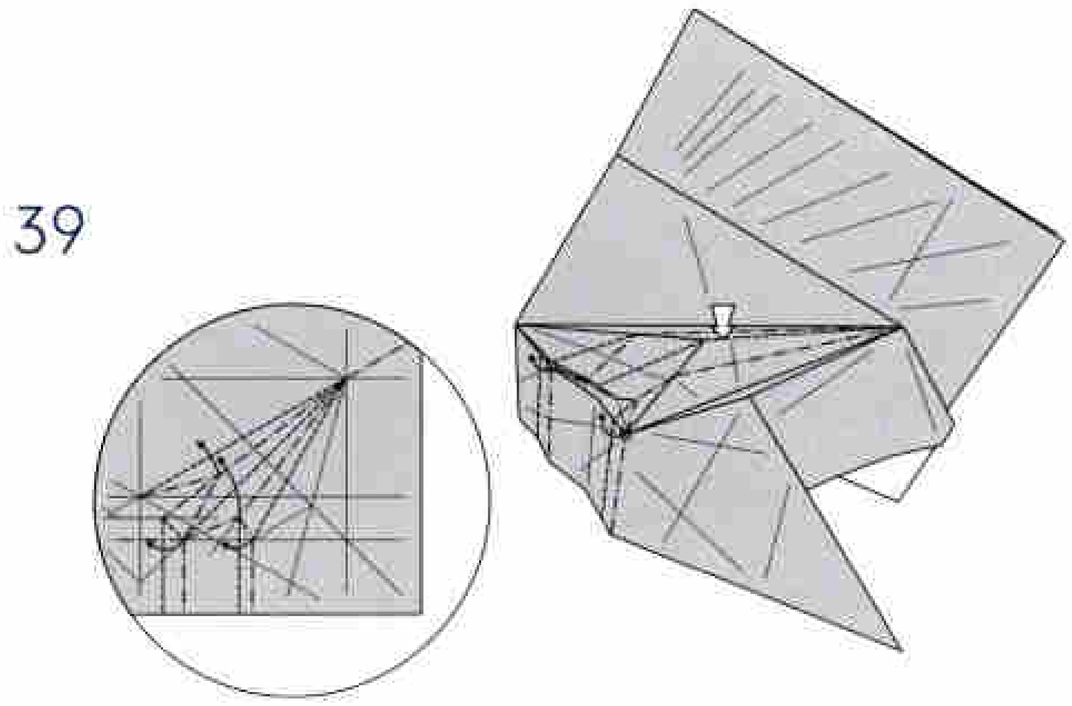
39
Sink the flap and collapse along creases.

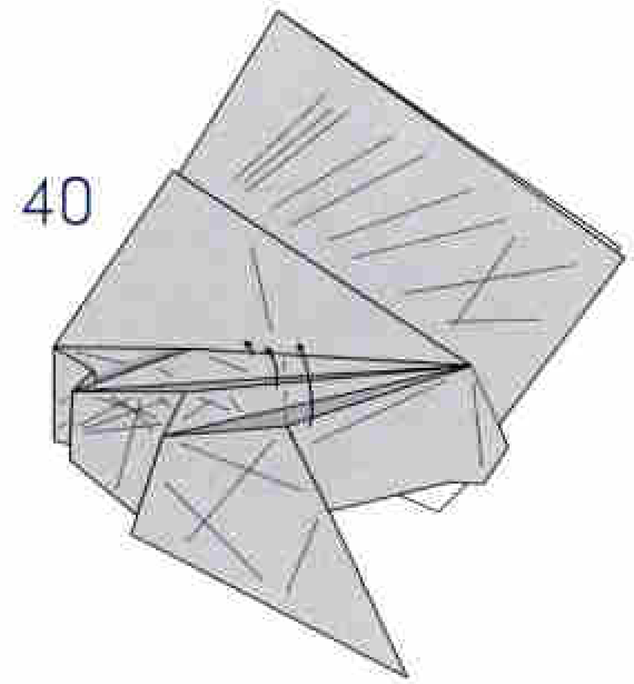
40
In progress.

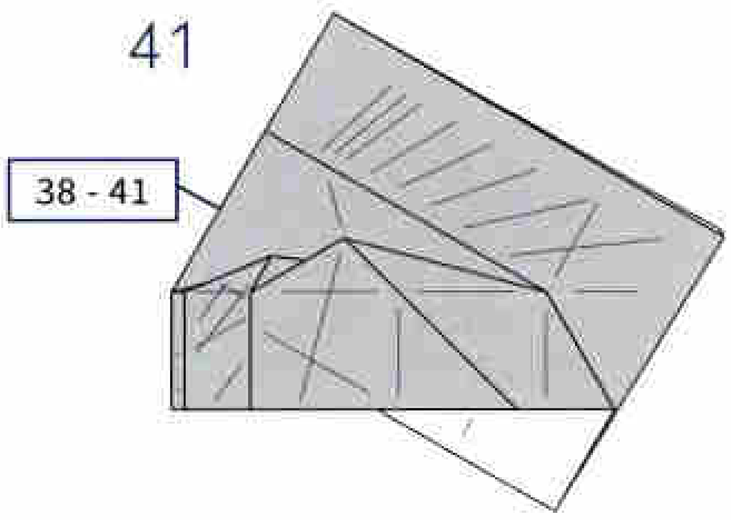
41
Repeat steps 38 to 41 behind.

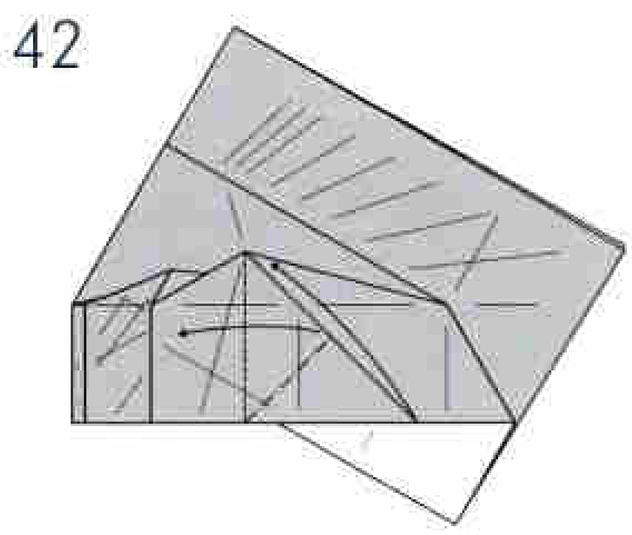








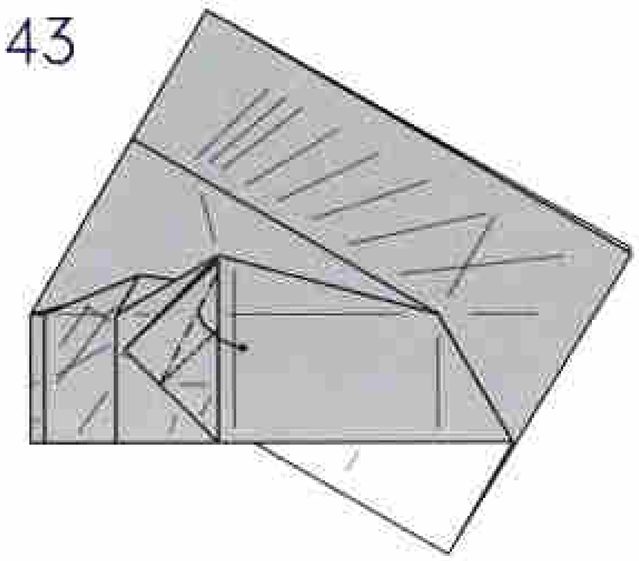




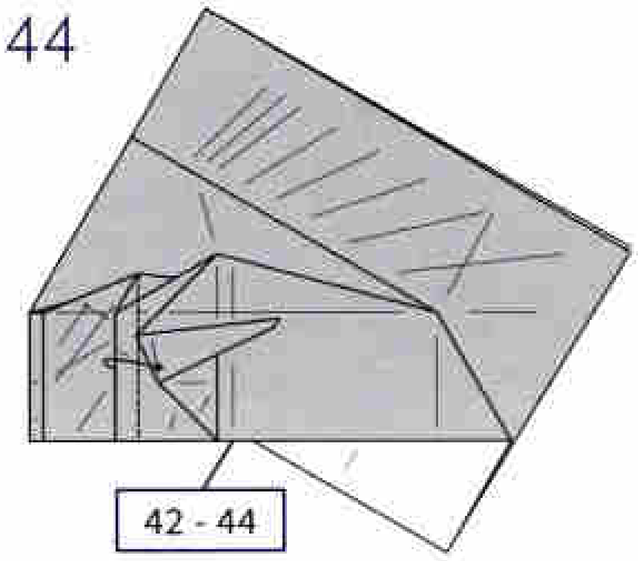
44
Valley fold.
Repeat steps 42
to 44 behind.

45
Angle bisector
to reference line.

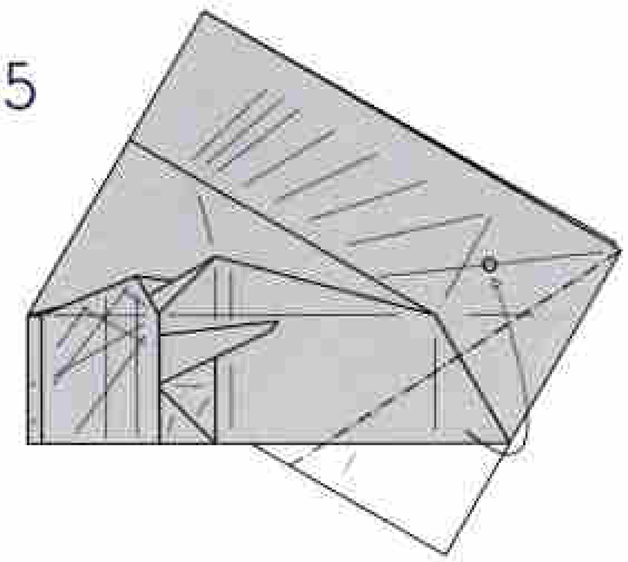
43



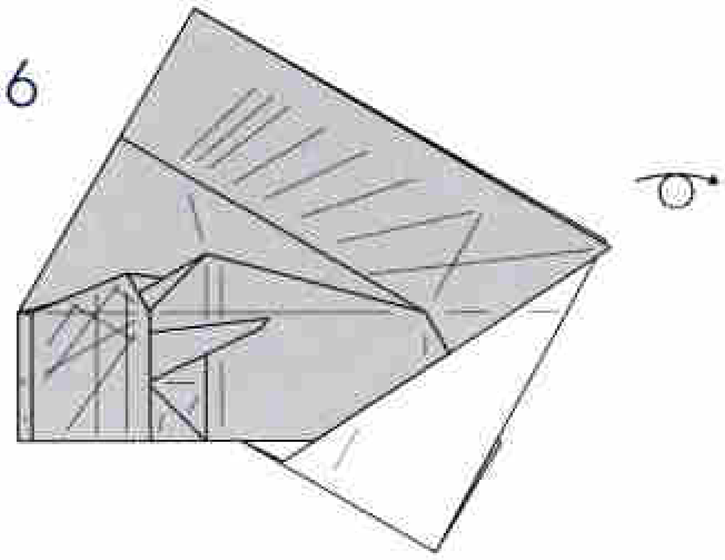
44



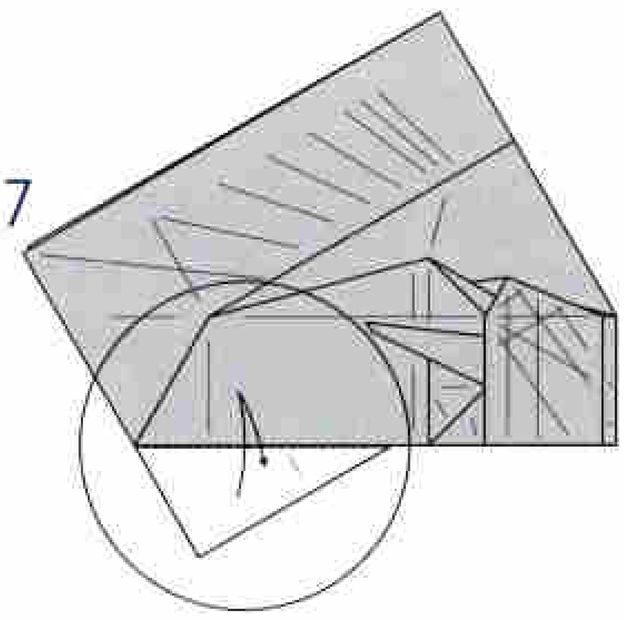
45



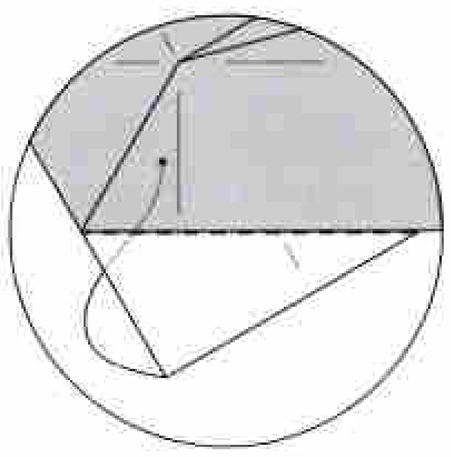
46



47



48



49
Mountain fold and squash.

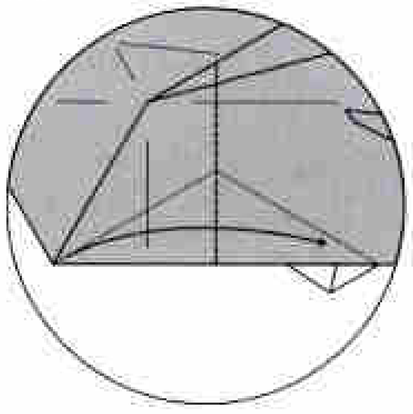
51
Inside reverse fold.

54
Pleat inside.

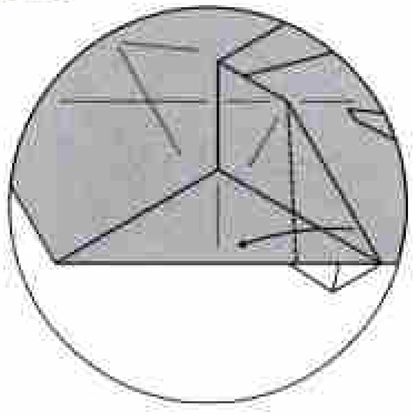
55
Inside reverse fold.

56
Inside reverse fold the inner flap.

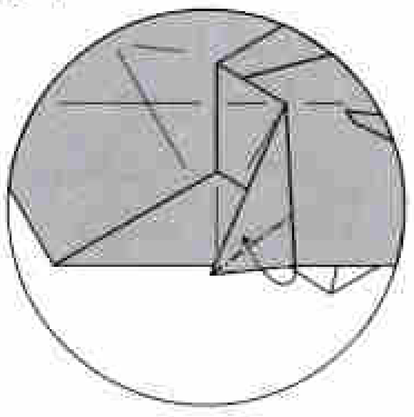
49



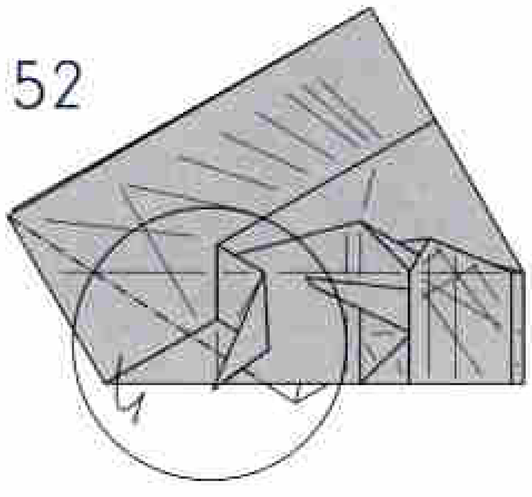
50



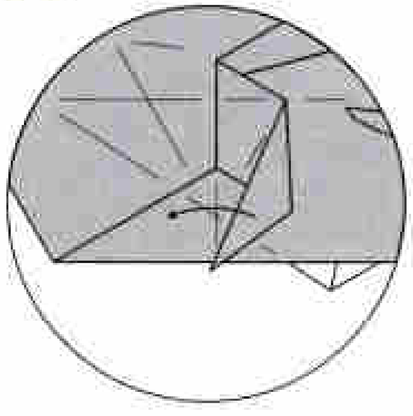
51



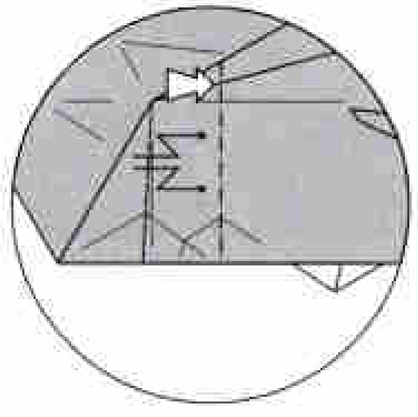
52



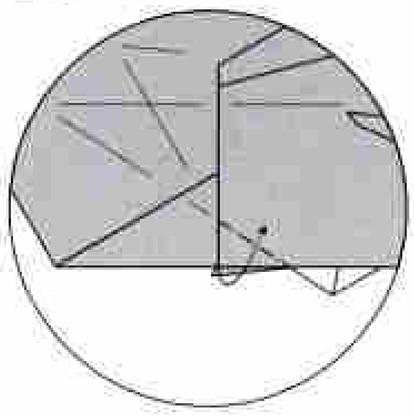
53



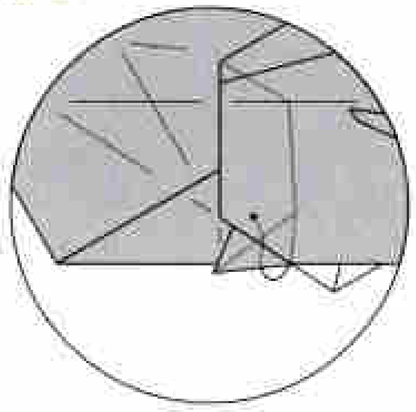
54



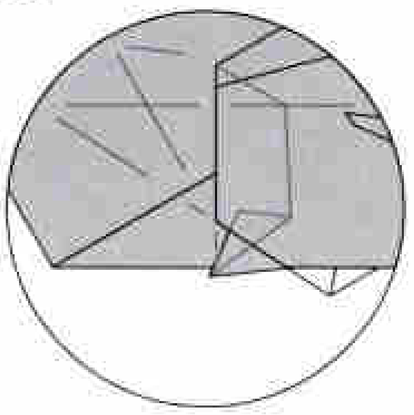
55



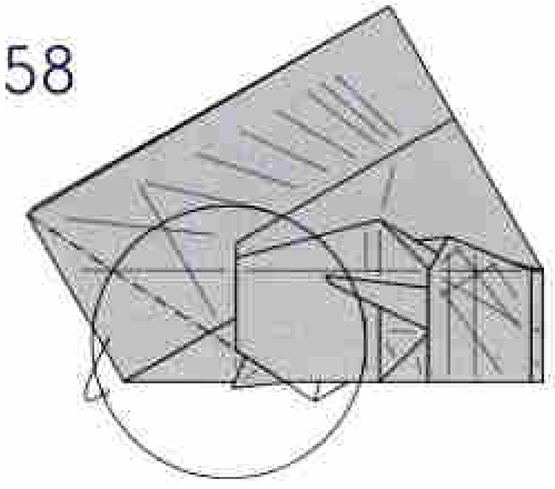
56



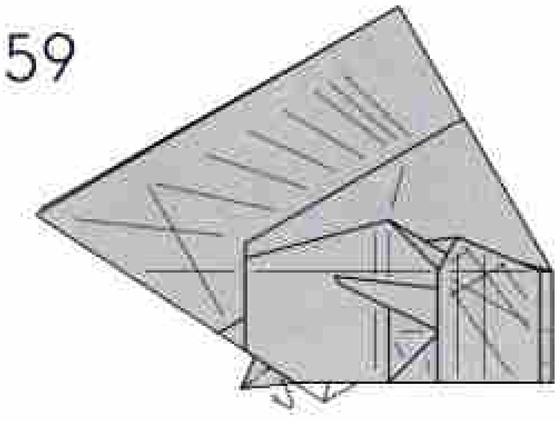
57



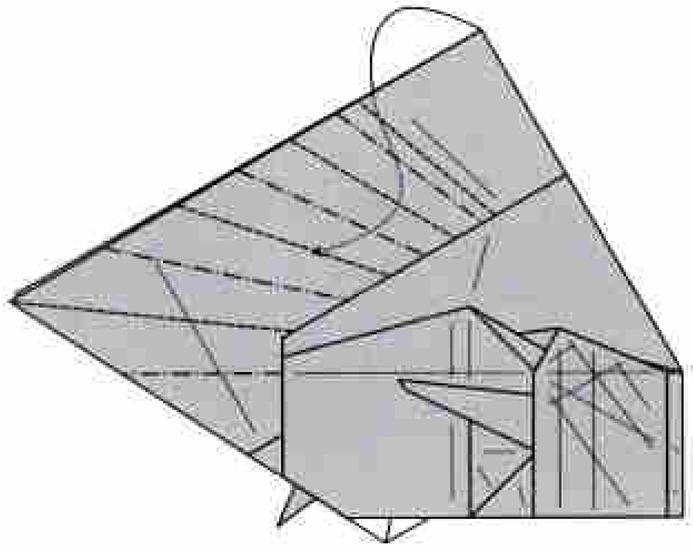
58



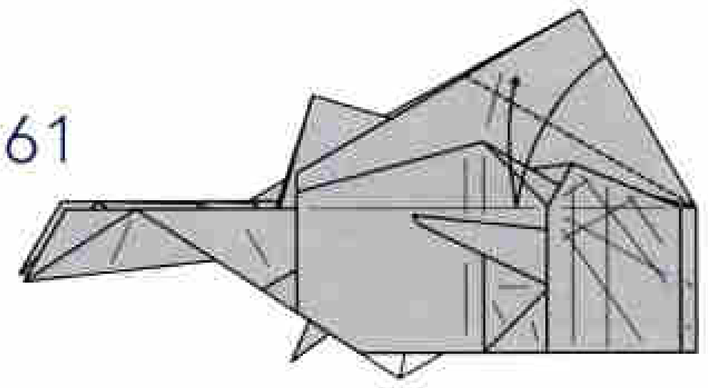
59



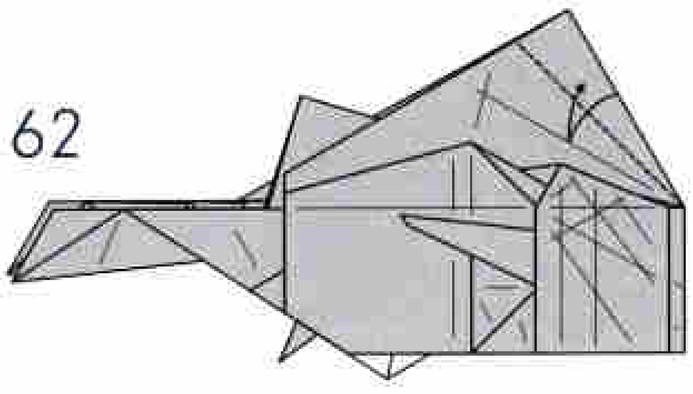
60



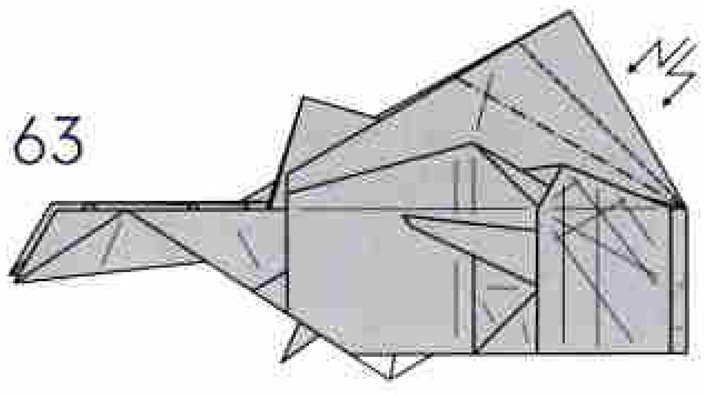
61



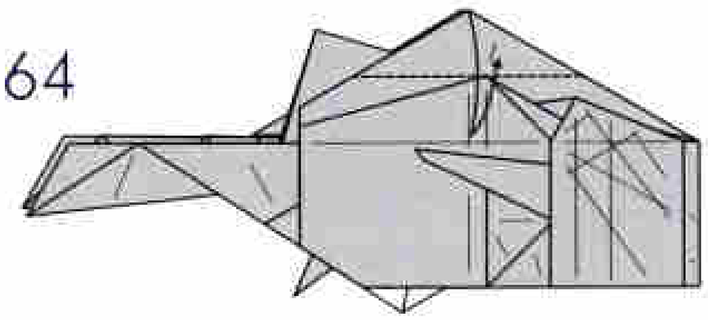
62



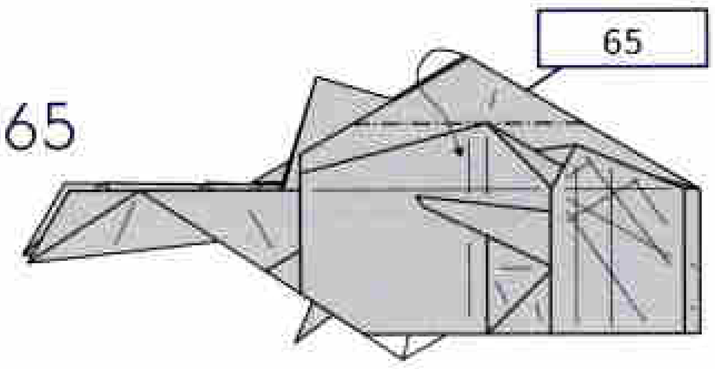
63



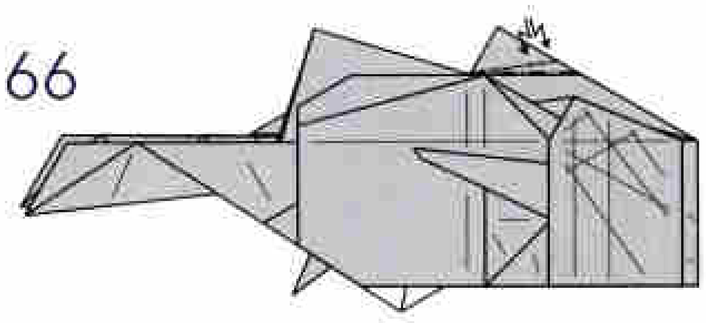
64



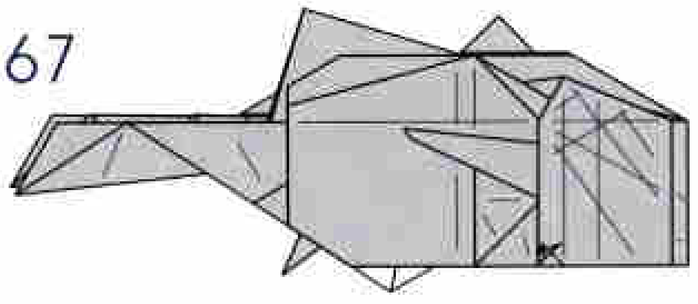
65



66



67



60
Pleat along creases. Note the last pleats.

63
Crimp inside.

65
Inside reverse fold. Repeat behind.

66
Crimp.

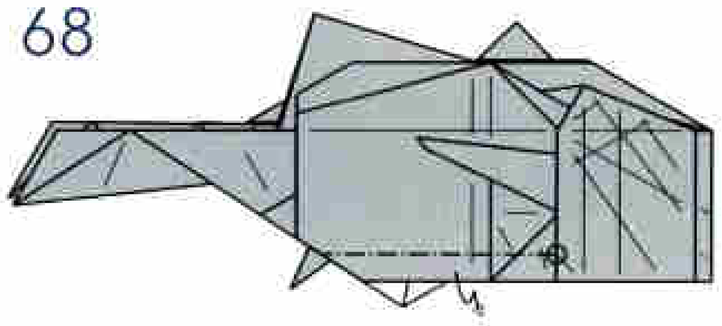
67
Valley fold and unfold.

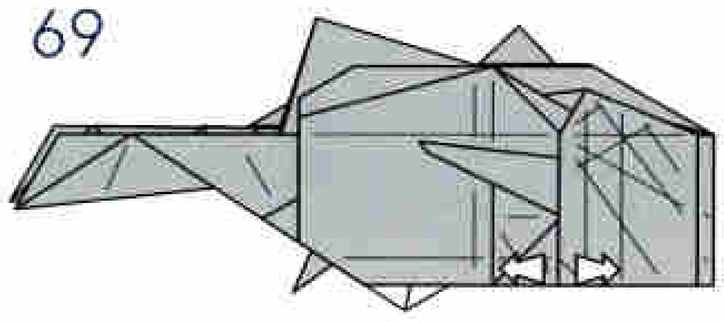
68
Mountain fold
and unfold.

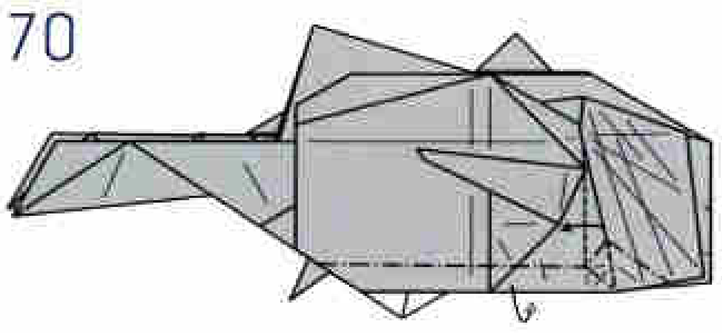
69
Open.

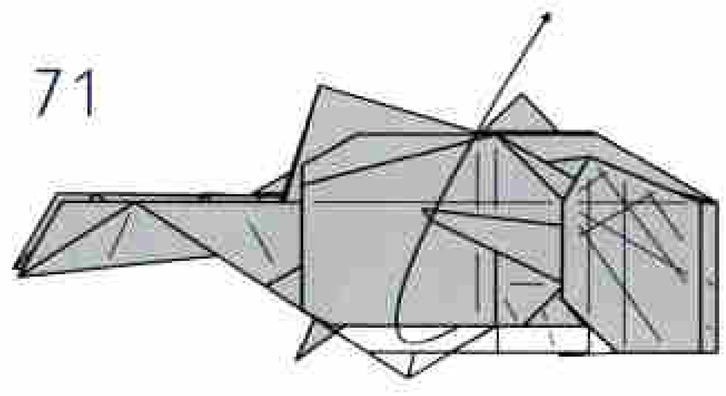
70
Collapse.

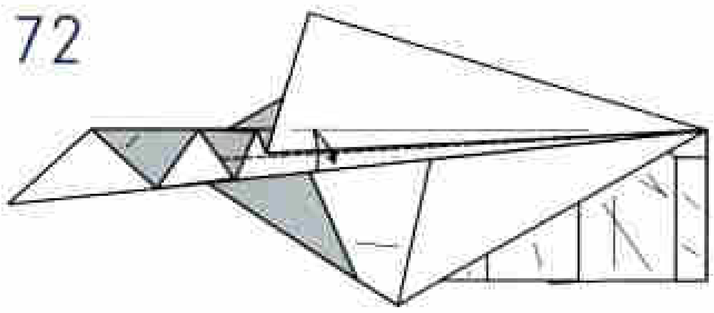
71
Lift and ignore
the top flap.

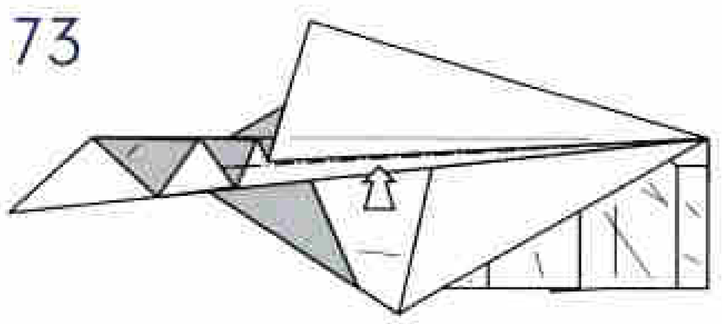


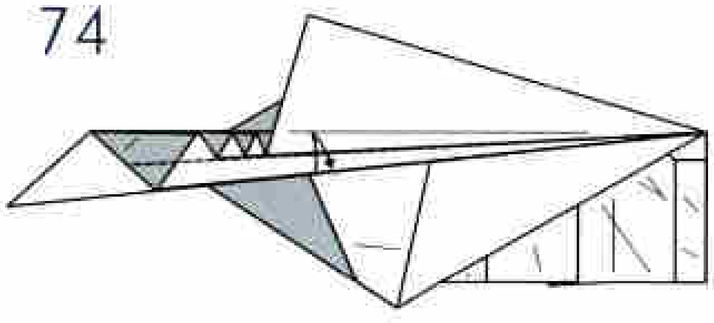


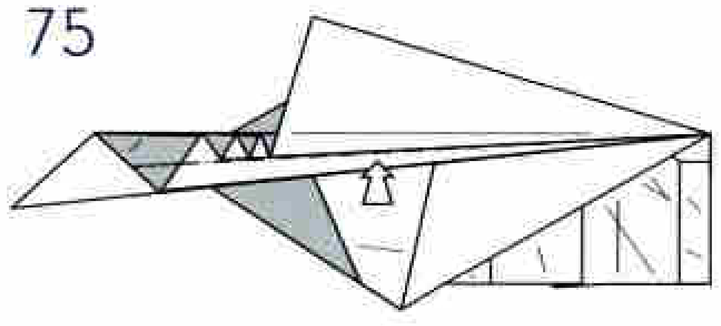


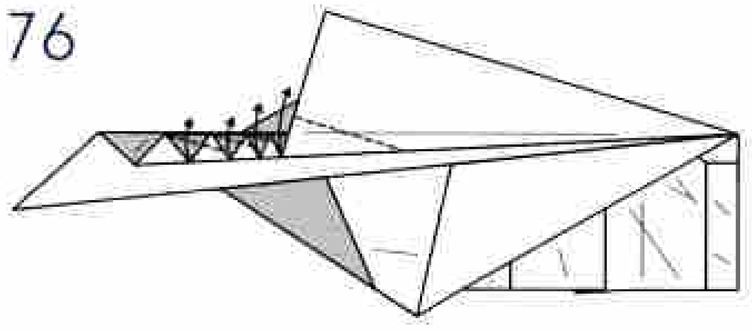


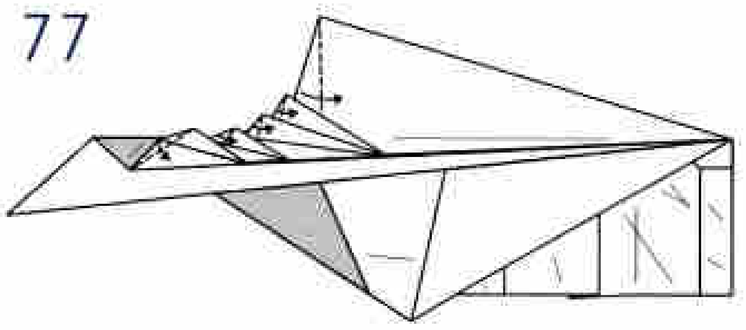


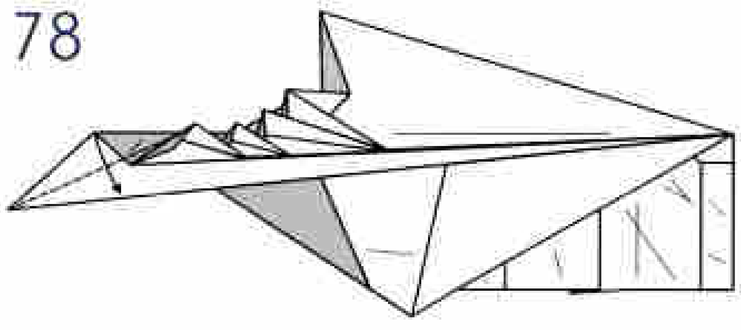


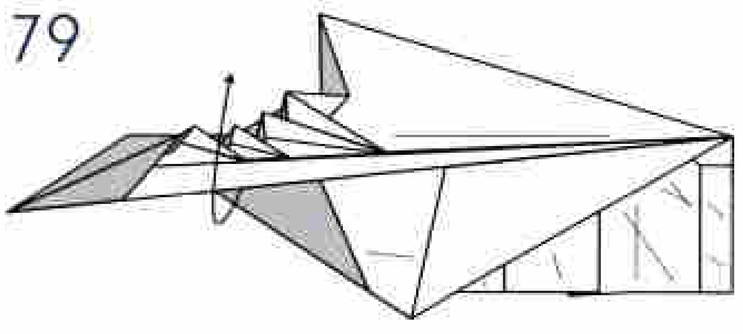


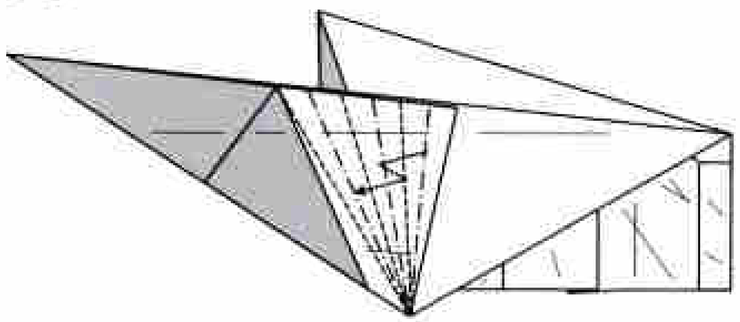


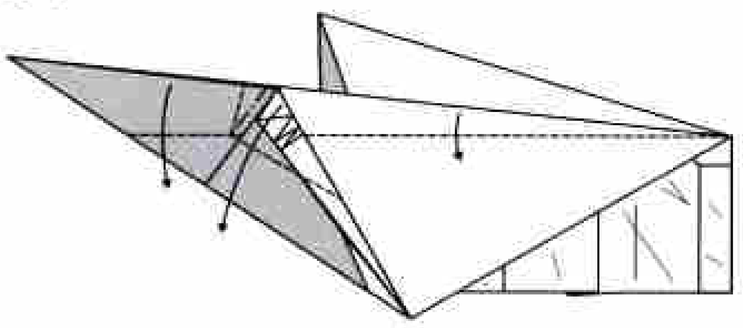
76


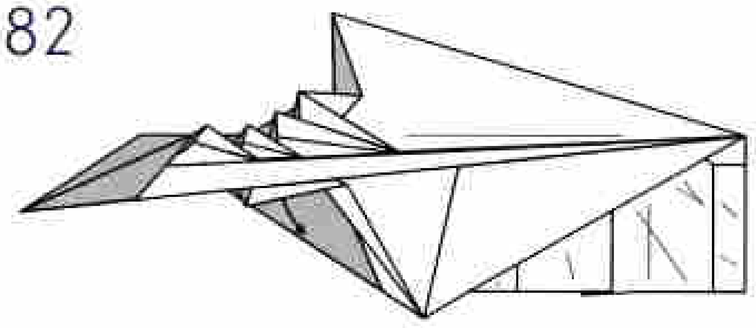
77


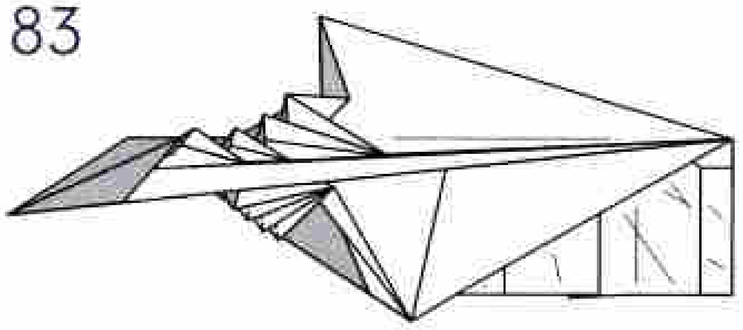
78


79


80


81


82


83


76
Valley folds.

77
Inside reverse folds.

80
Pleat.

81
Collapse as shown.

82
Spread.

83
Inside reverse folds.

84
Inside reverse folds completed. Flip over and view the other side.

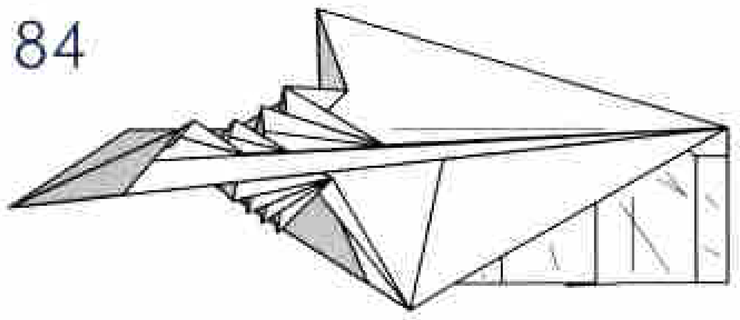
85
Unsink.

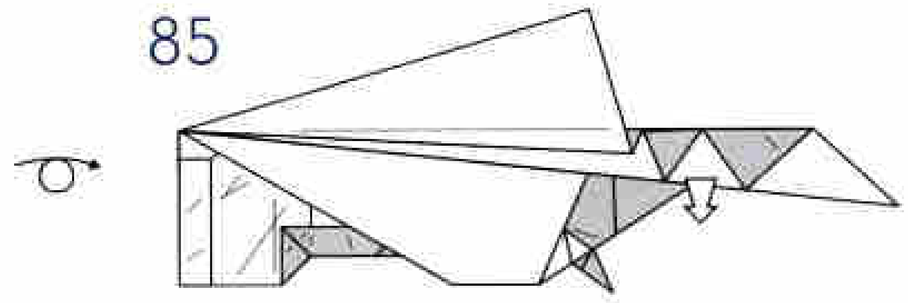
86
Bring the edge of the flap to the imaginary line.

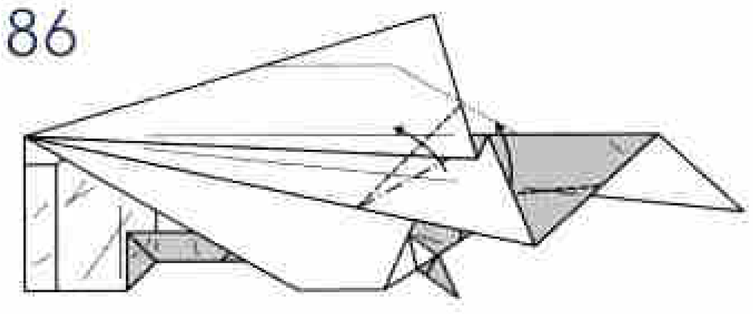
87
Inside reverse fold.

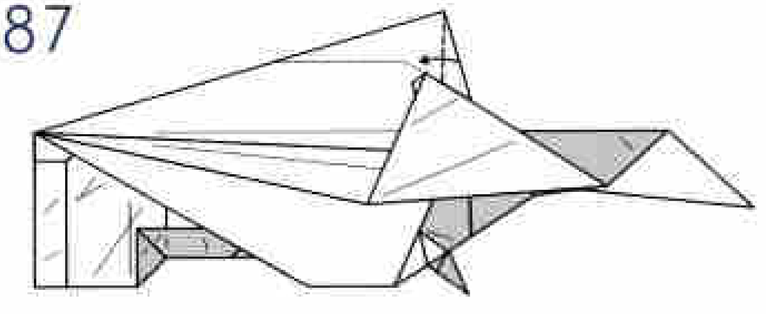
89
Inside reverse fold.

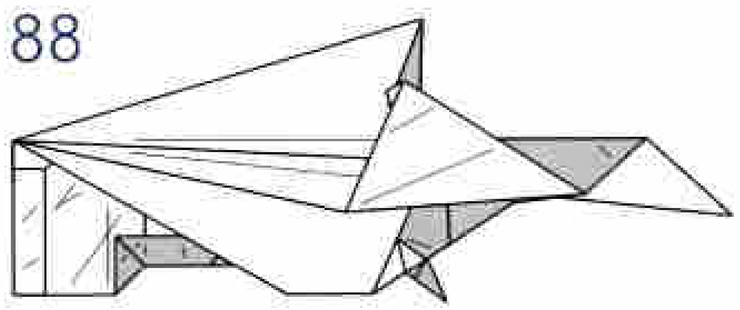
91
Tuck the flap into the pocket.

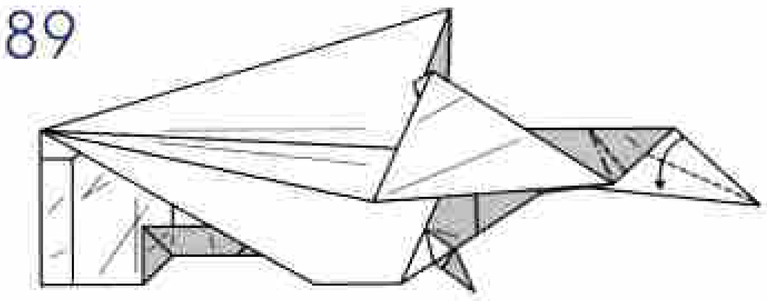


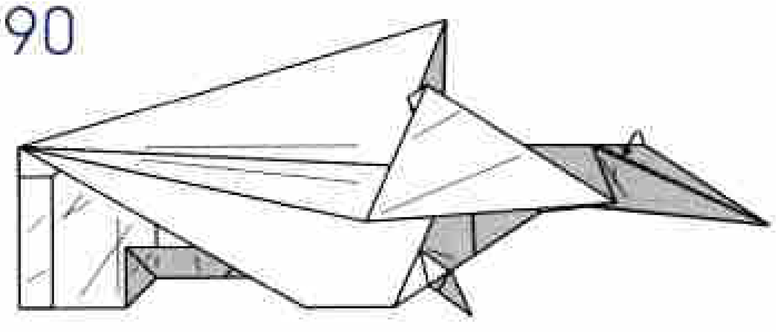


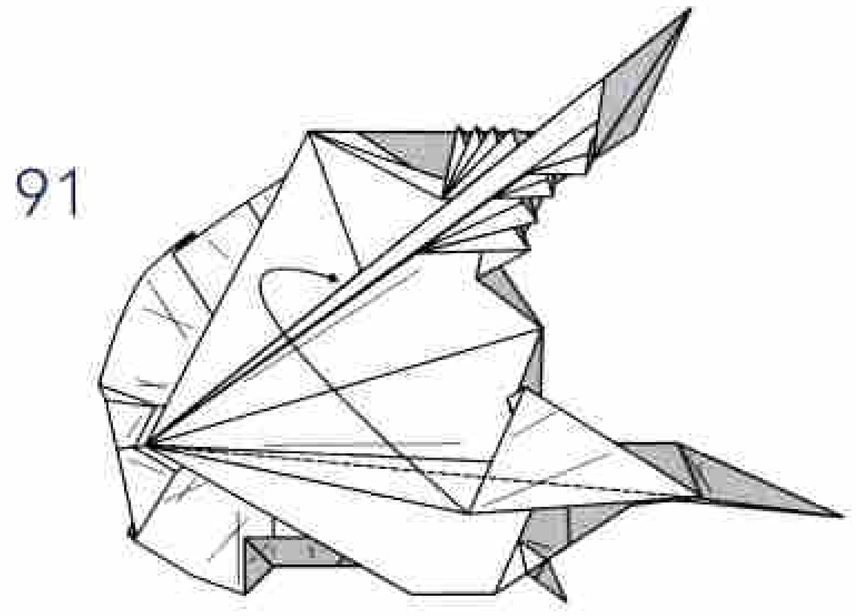




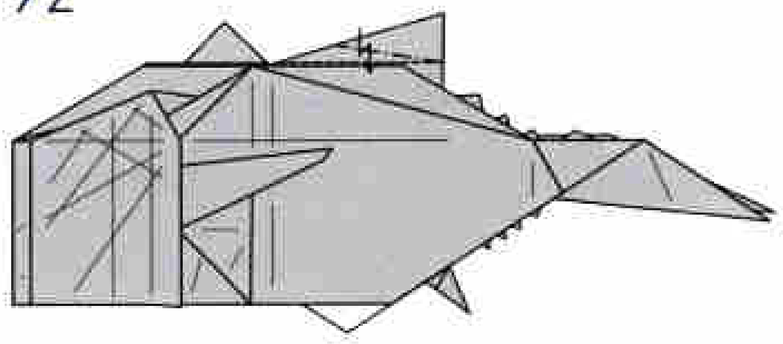




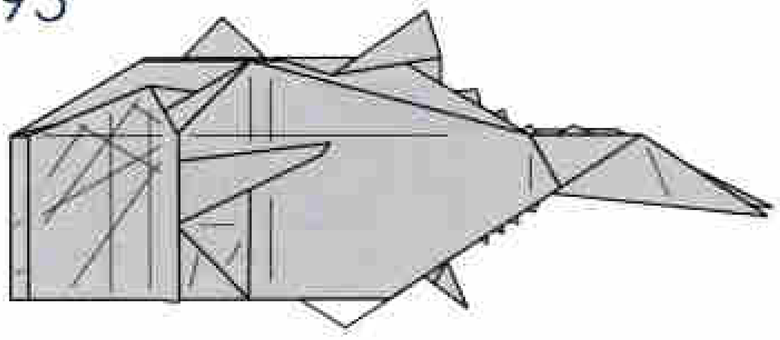




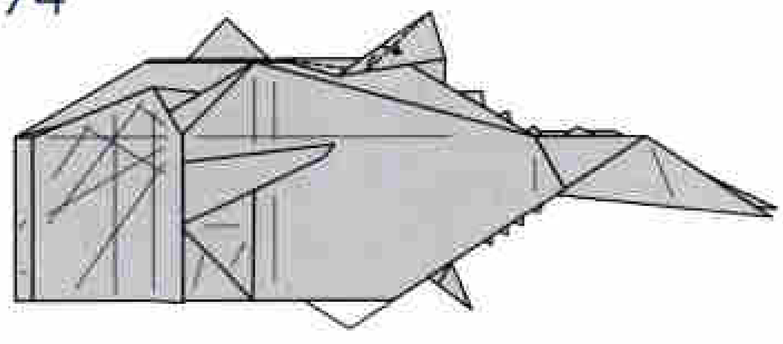
92



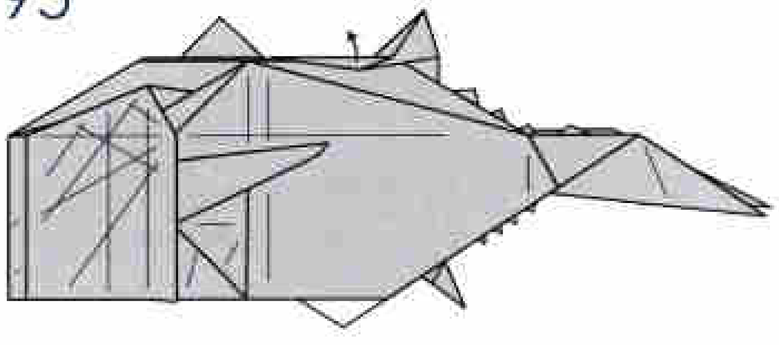
93



94



95



92
Crimp.

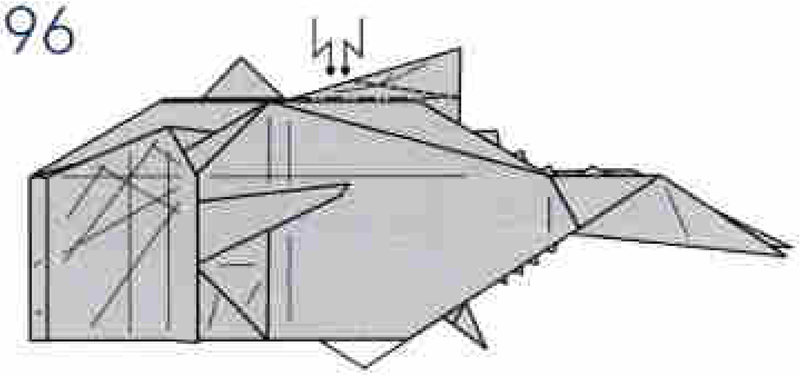
95
Unfold.

96
Crimp inside.

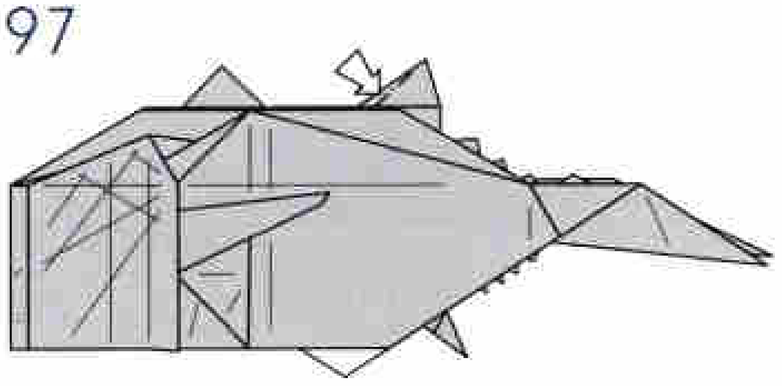
97
Sink along creases made in step 94.

99
Inside reverse fold.

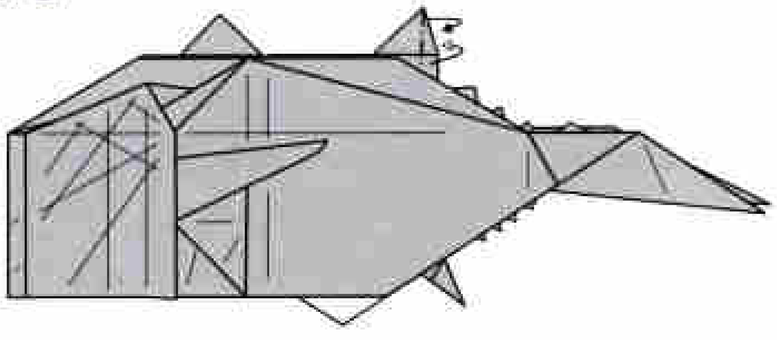
96



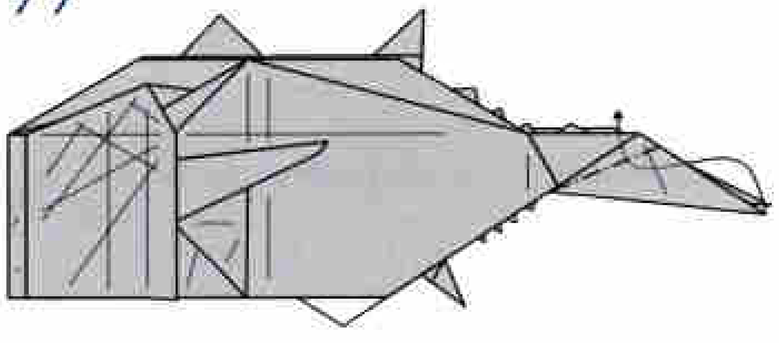
97



98



99



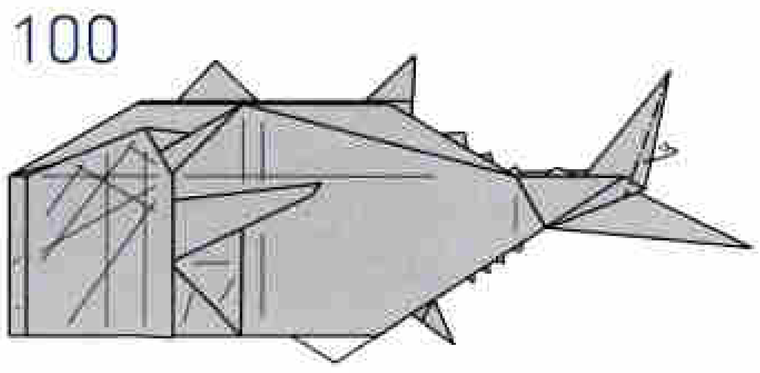
101
Valley fold into the other fin.

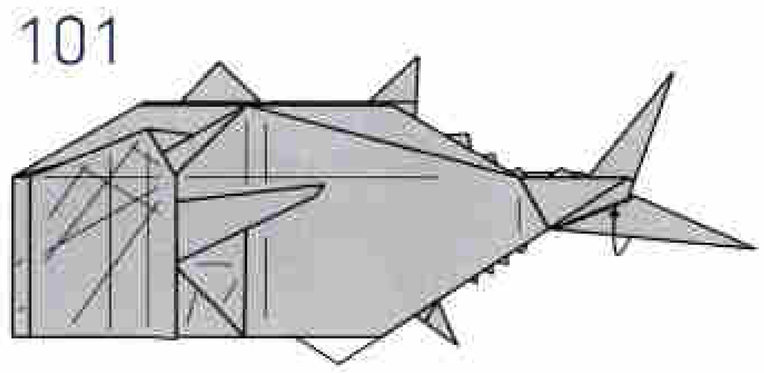
102
Valley fold.

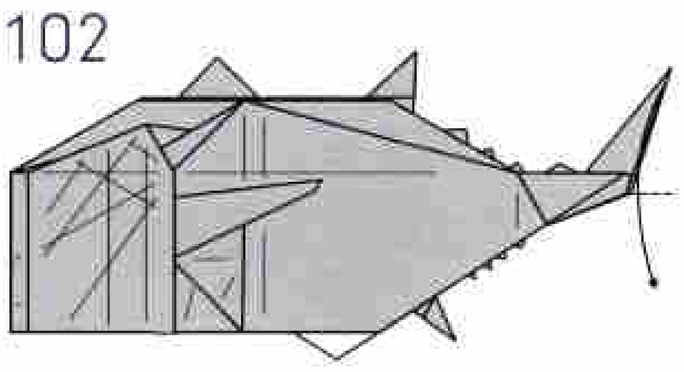
104
Repeat steps 67 to 70.

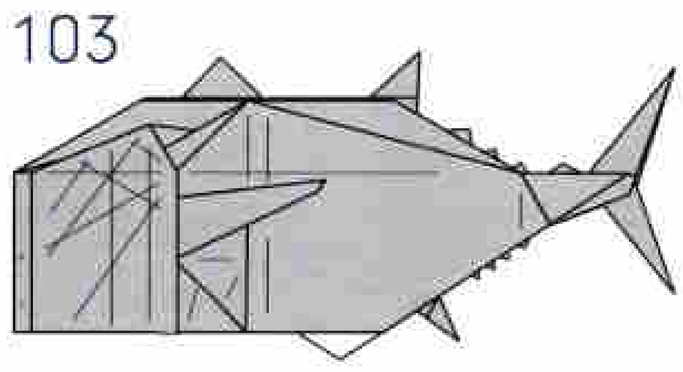
106
Inside reverse fold the inner flap.

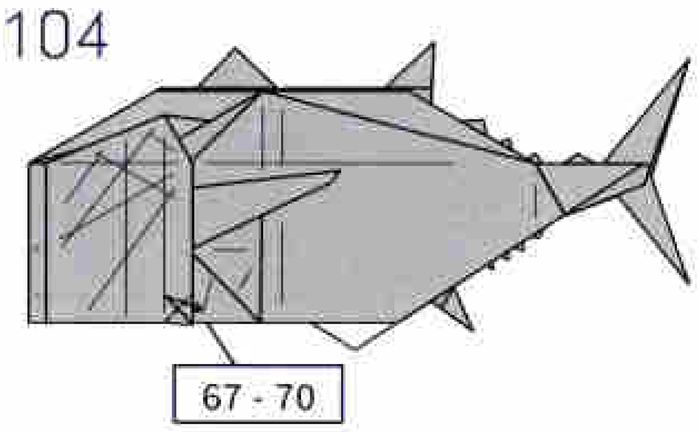
107
Valley fold. Repeat behind.

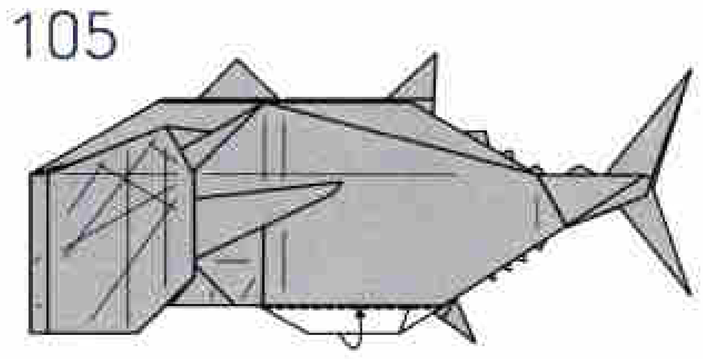


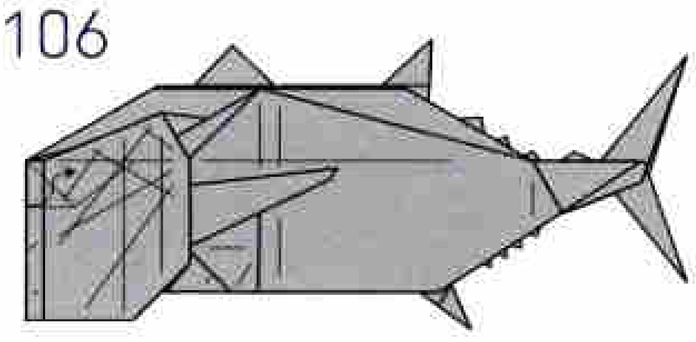


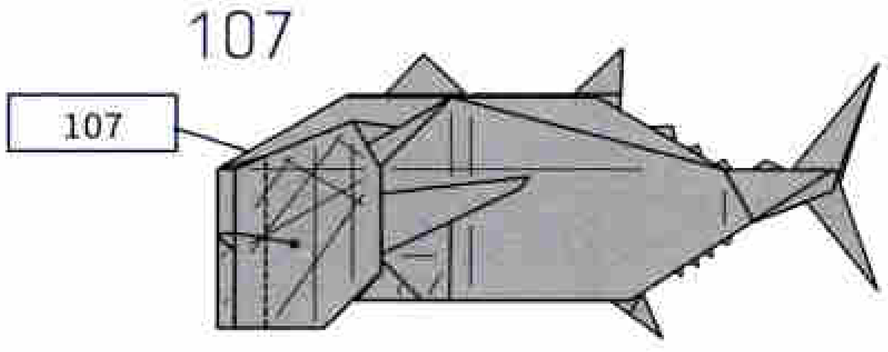




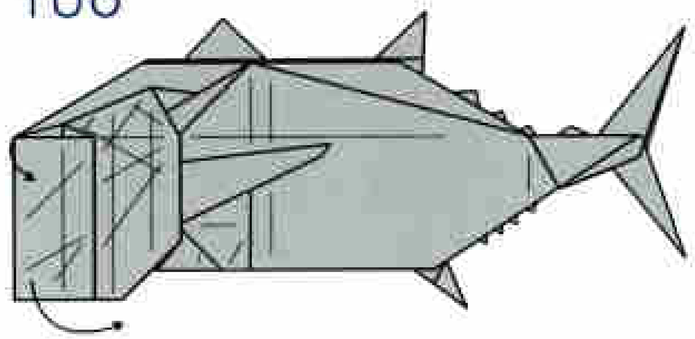




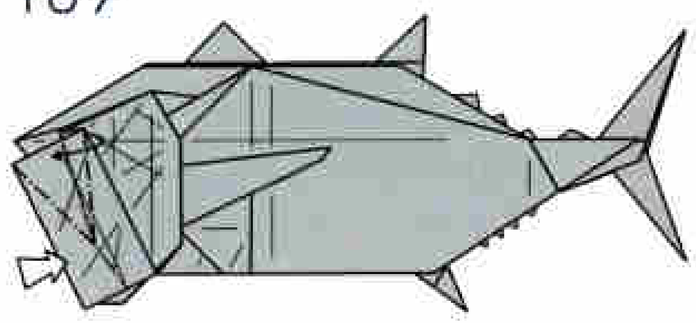




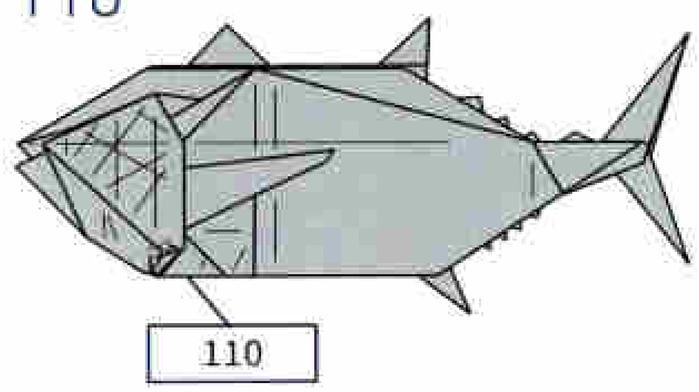
108



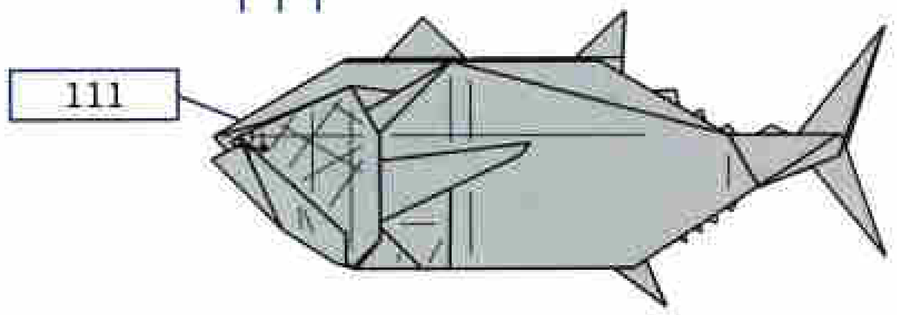
109



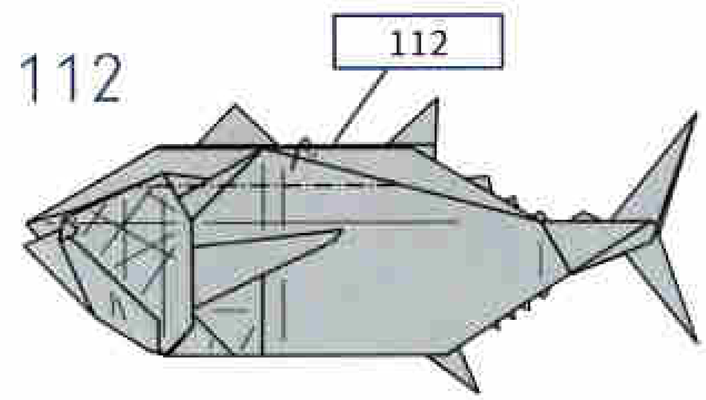
110



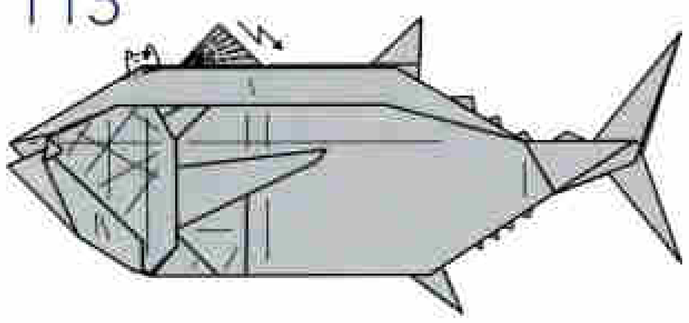
111



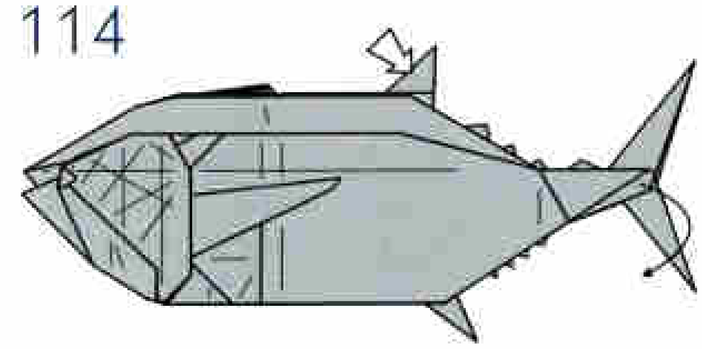
112



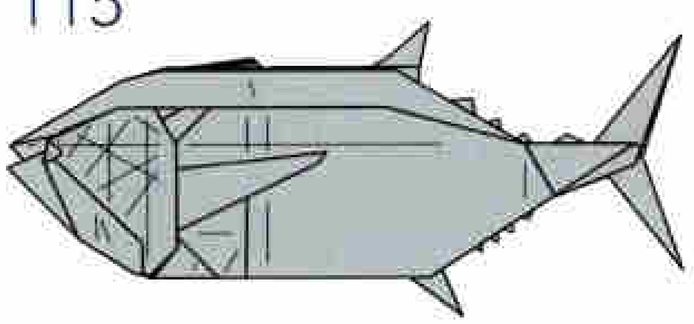
113



114



115



108
Shift.

109
Inside reverse fold the lower jaw and collapse as shown.

110
Mountain fold the corner. Repeat behind.

111
Valley fold the eye. Repeat behind.

112
Valley fold. Repeat behind.

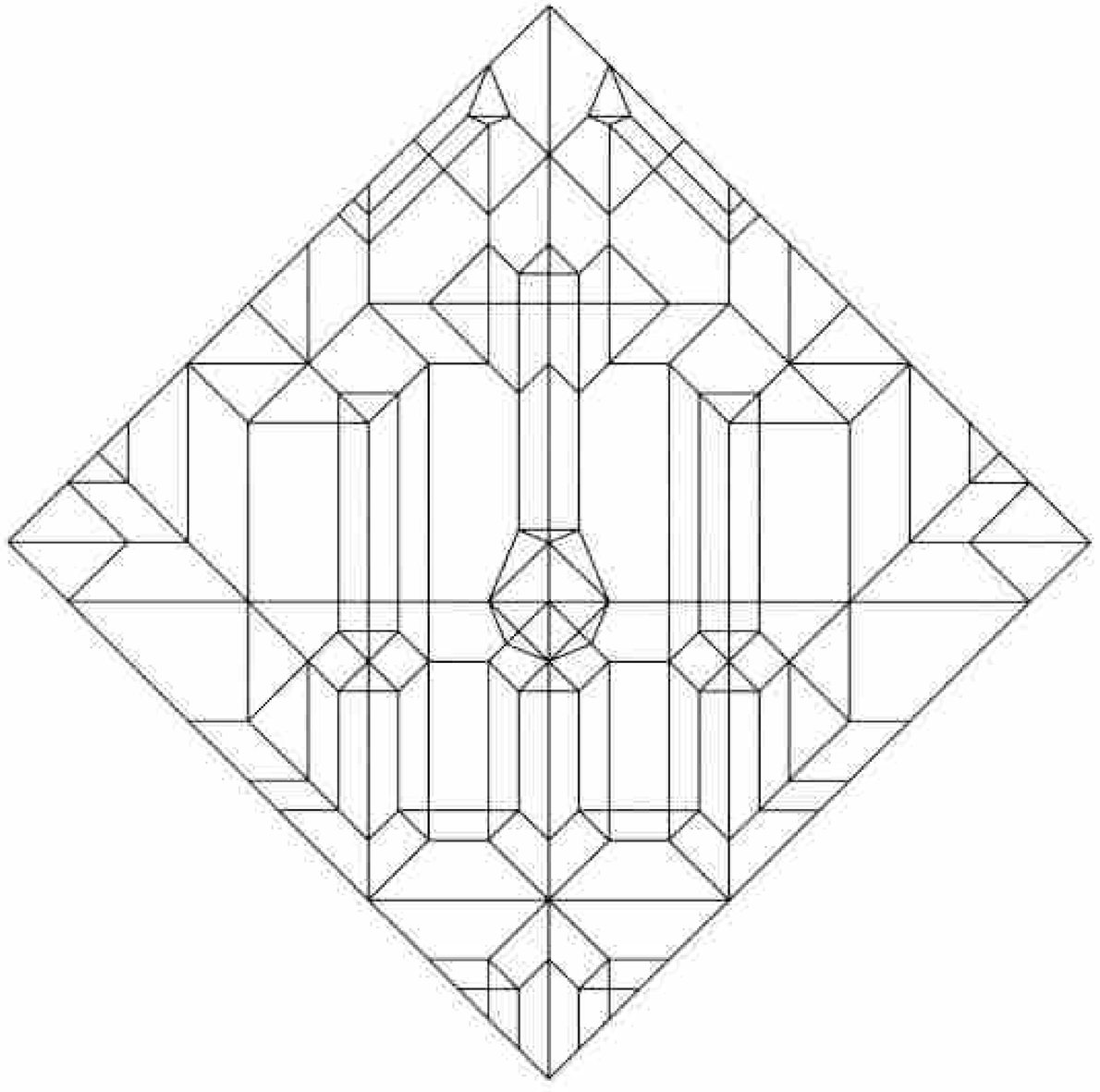
114
Shape.

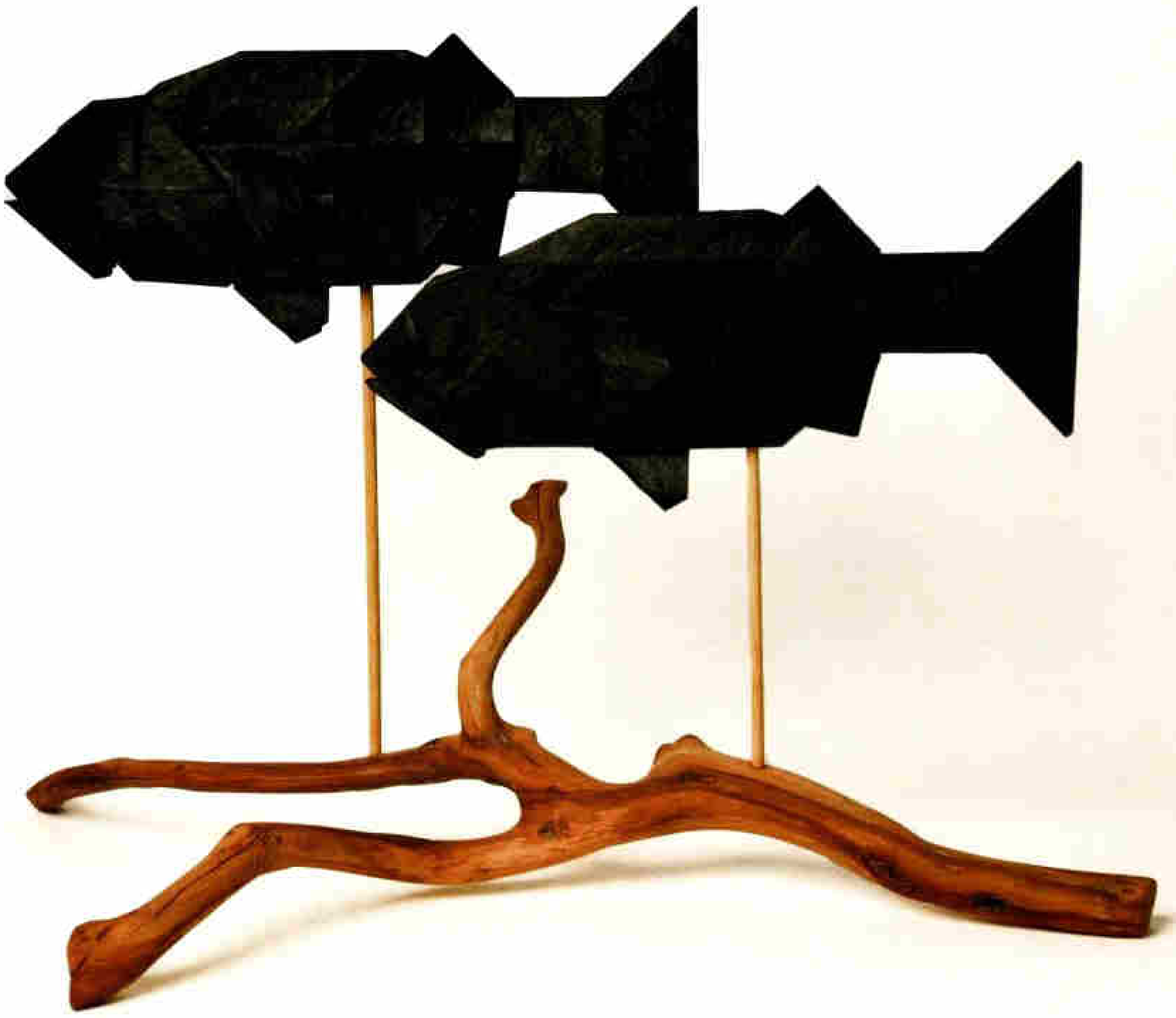
115
Tuna completed.

Giant Sea Bass

Ever since I encountered the giant sea bass on a dive, I have always wanted to add this species to my collection of designs. I was able to design this fish by forming the tail first, then progressing toward the front of the body. For this model, I maintained a consistent boxpleated style and made sure all the angles and proportions were as accurate as possible. Sometimes strict boxpleating in design can make certain models look unnaturally gridded, but in this case, the angles helped emphasize the bulkiness of this fish.

The presentation of this fish design is what makes this piece stand out. I folded two models and positioned them over a section of manzanita wood. The wooden base contributes greatly to the balanced, natural look of the artwork.





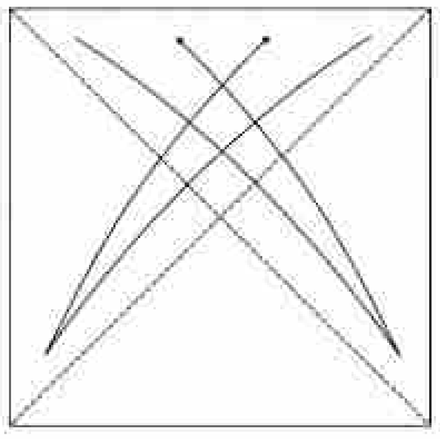
3

Fold and unfold.
Crease at the
intersection.

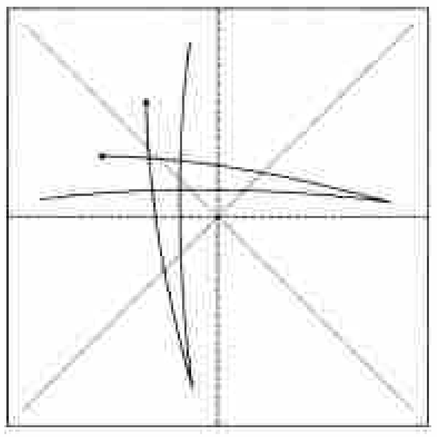
10

Fold and unfold.
Crease at the
intersection.

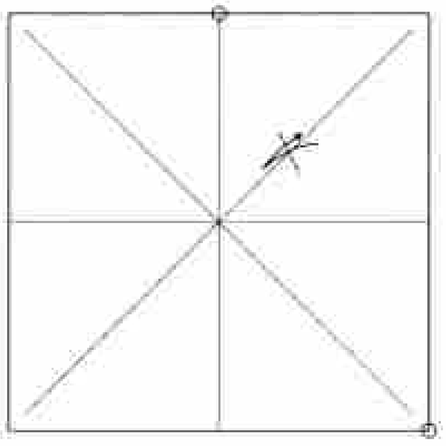
1



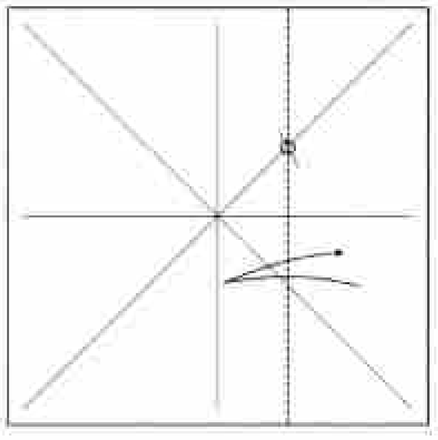
2



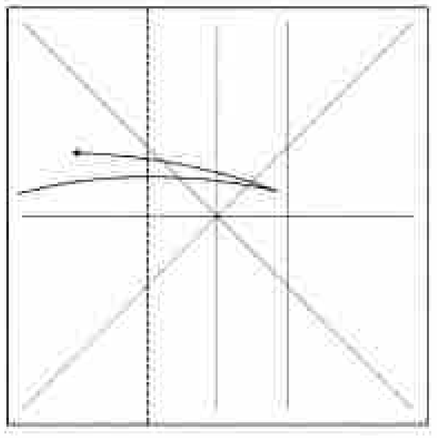
3



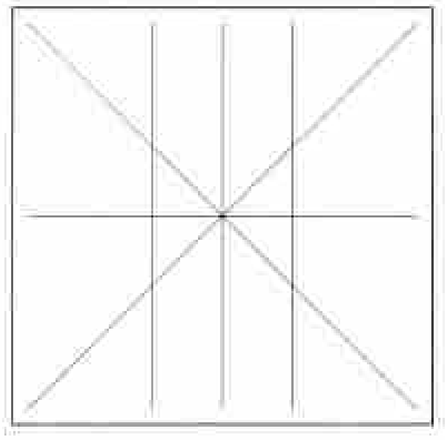
4



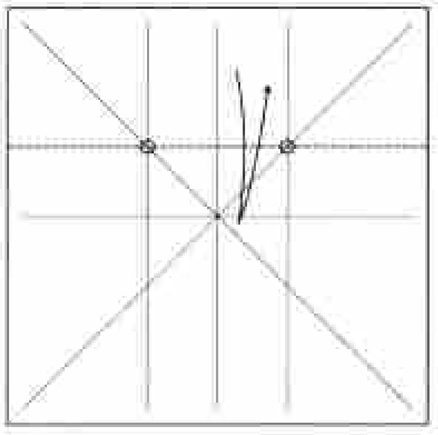
5



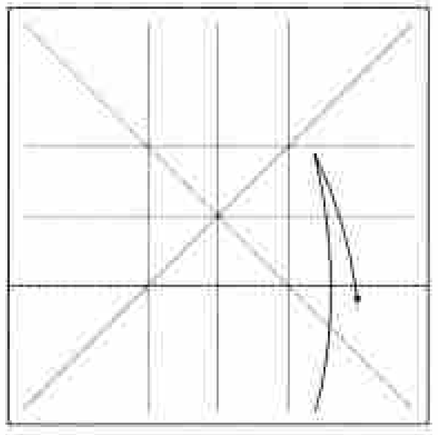
6



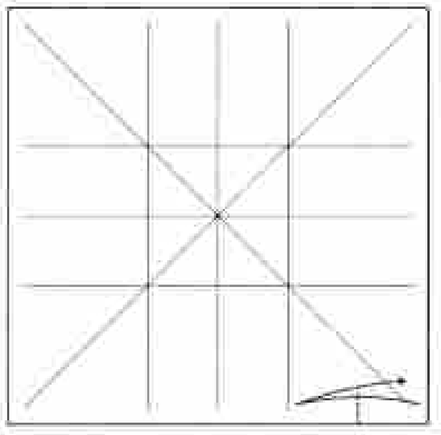
7



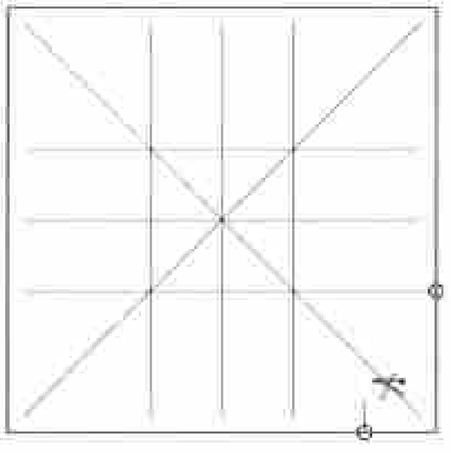
8



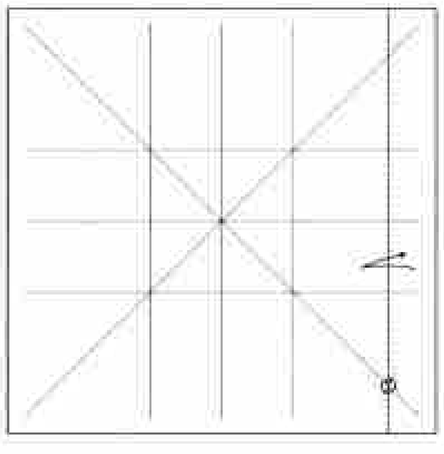
9



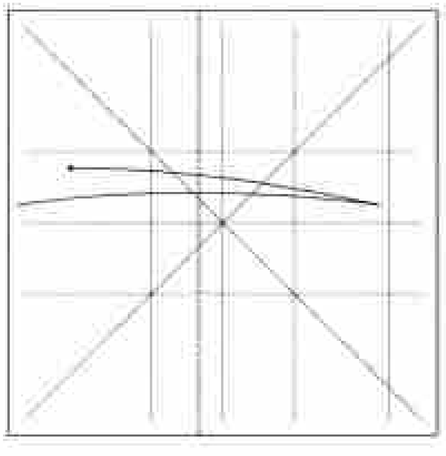
10



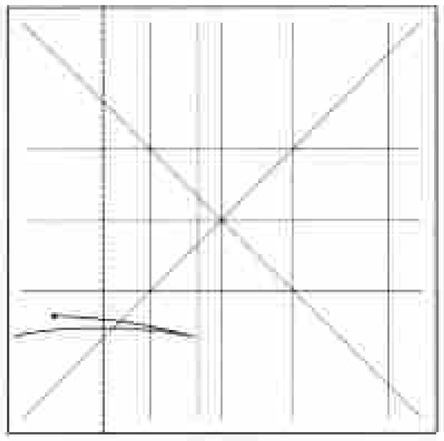
11



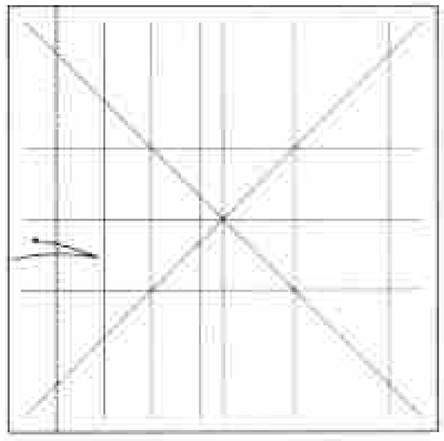
12



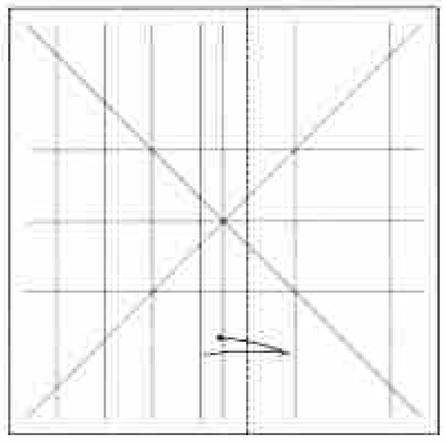
13



14



15



18

Repeat steps 11 to 16.

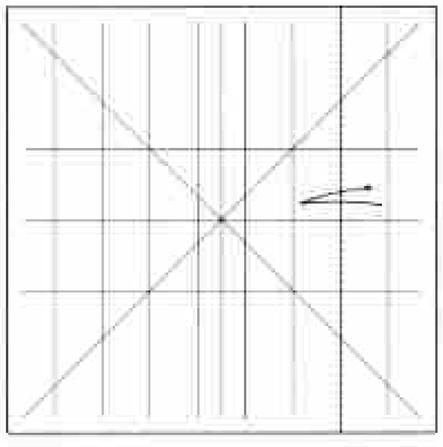
19

9 x 9 grid completed. Rotate.

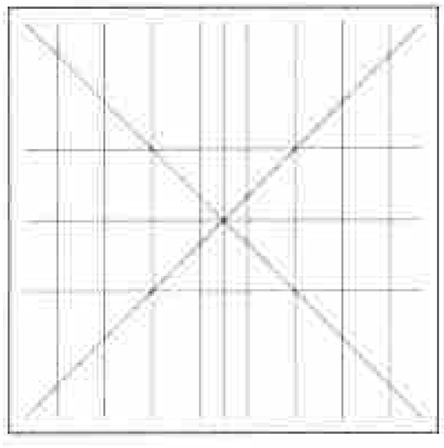
24

Repeat steps 20 to 24 on all sides.

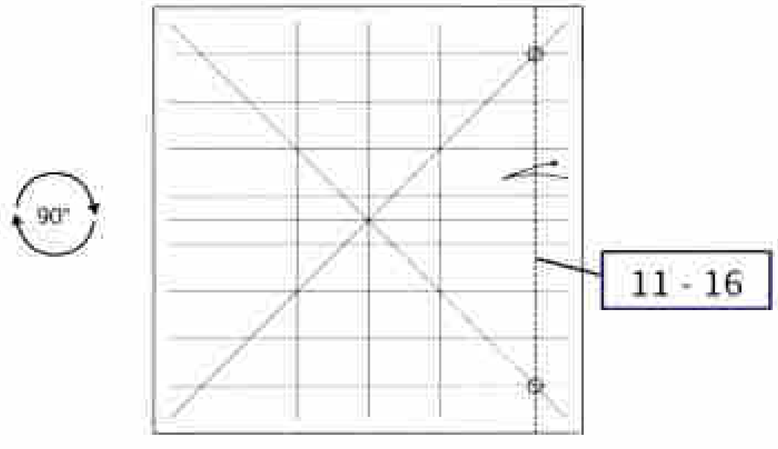
16



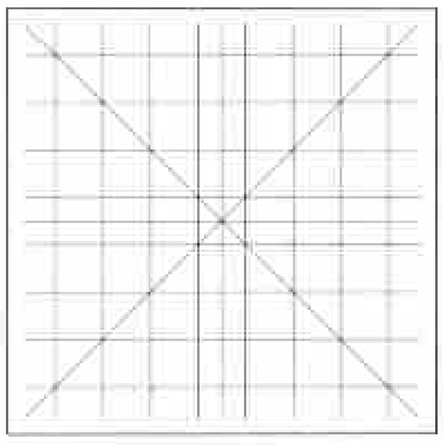
17



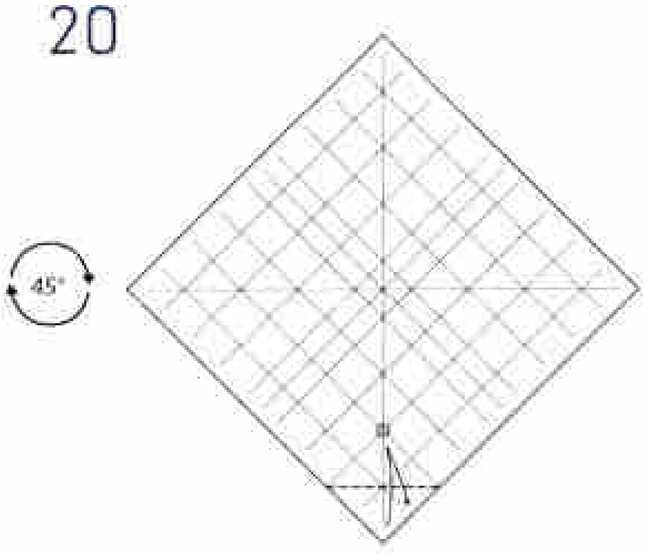
18



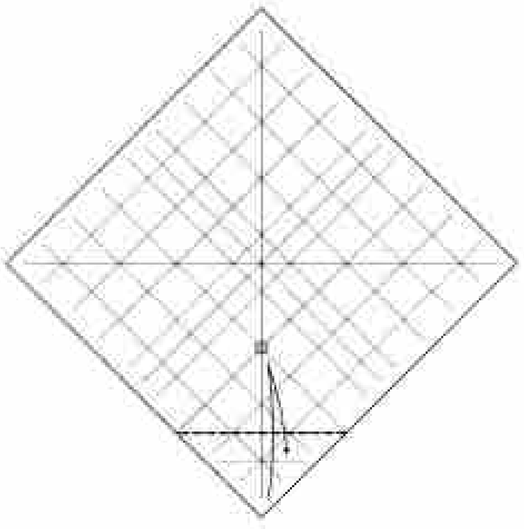
19



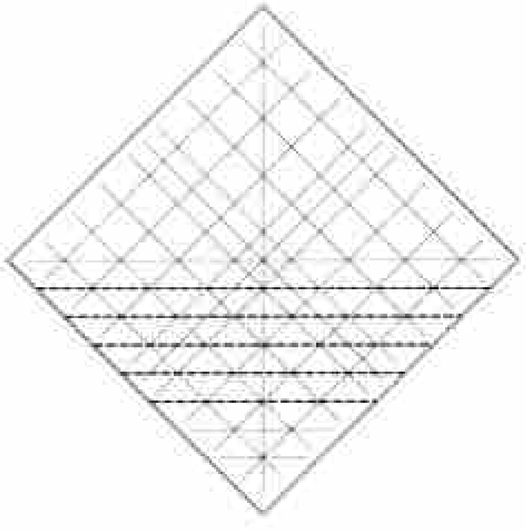
20



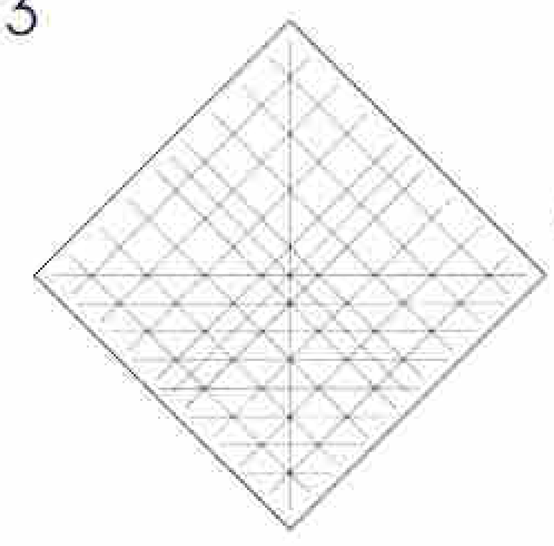
21



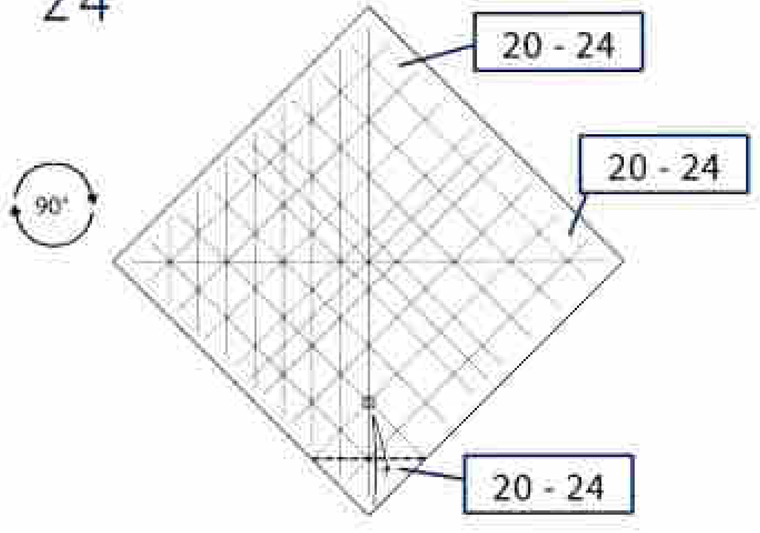
22



23



24

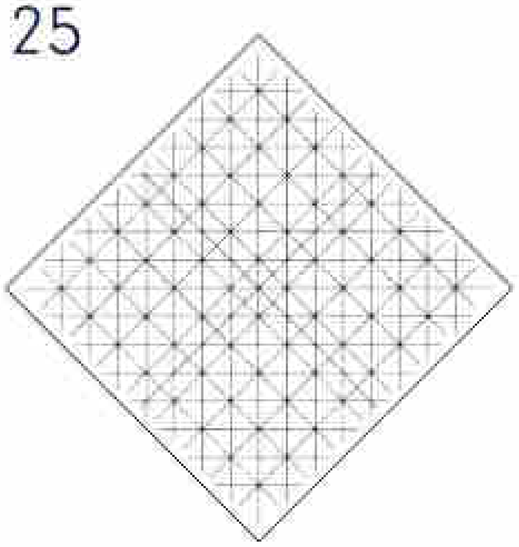


33
Pleat.

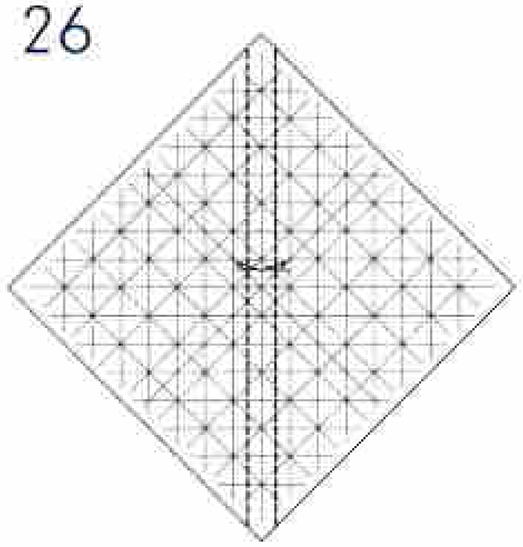
34
Pleat.

36
Rotate.

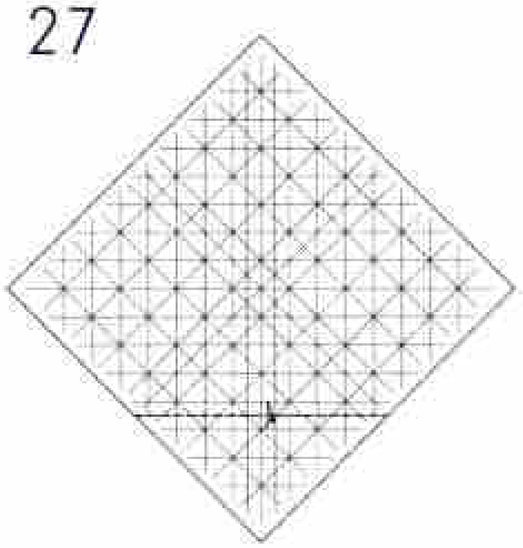
25



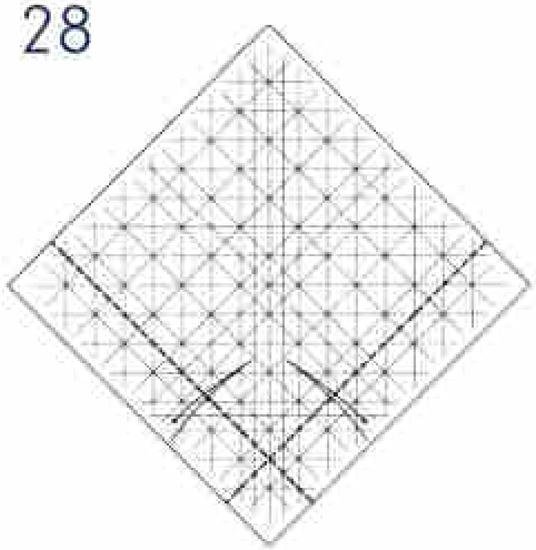
26



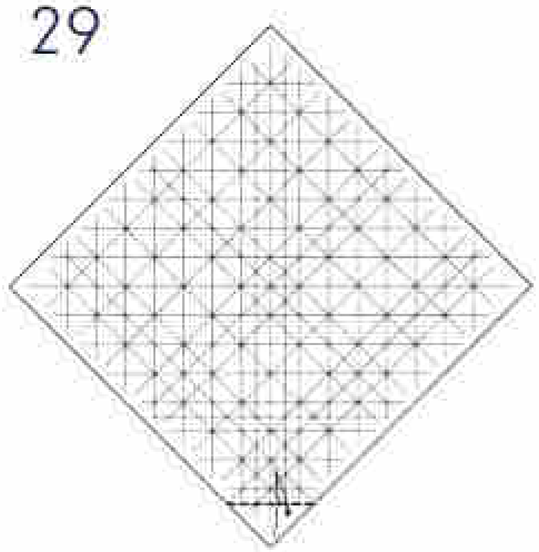
27



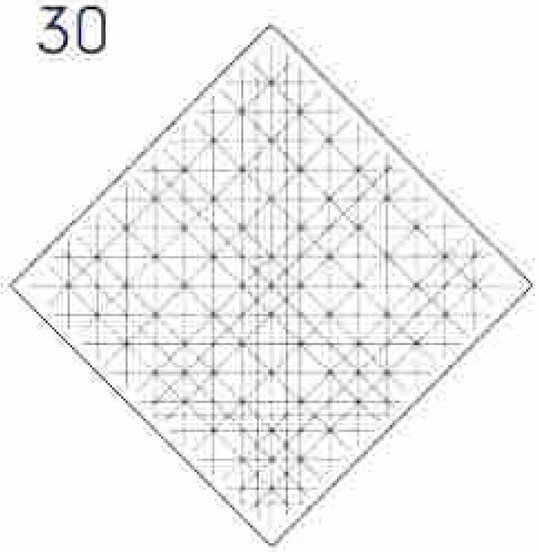
28



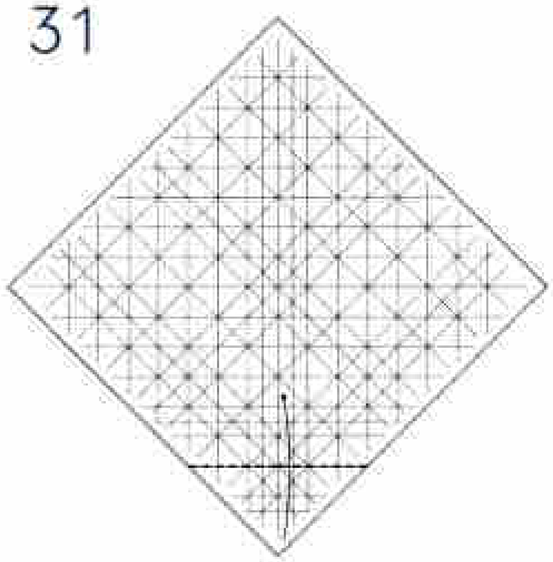
29



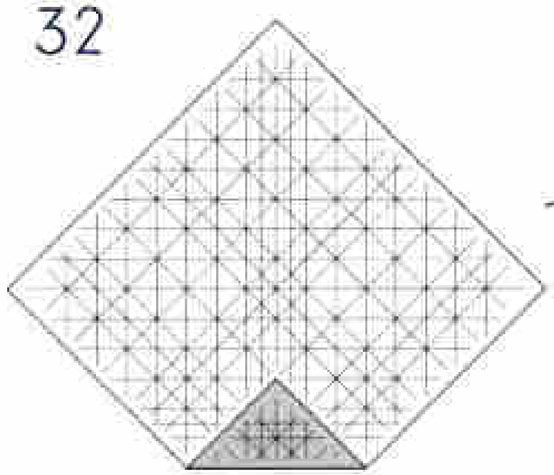
30



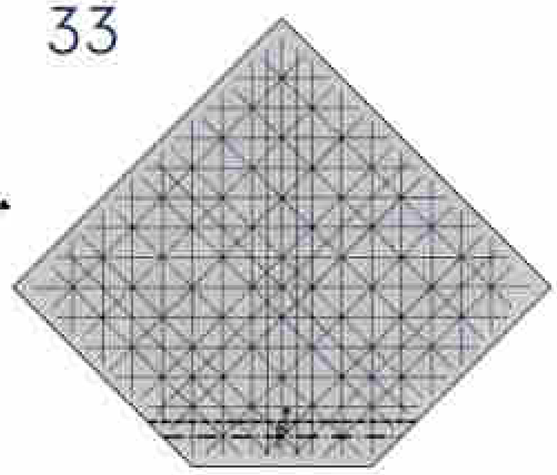
31



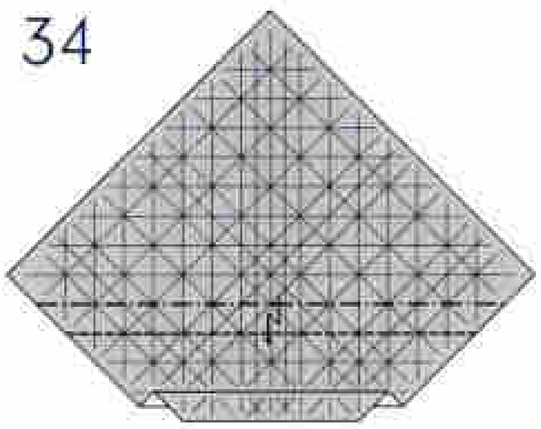
32



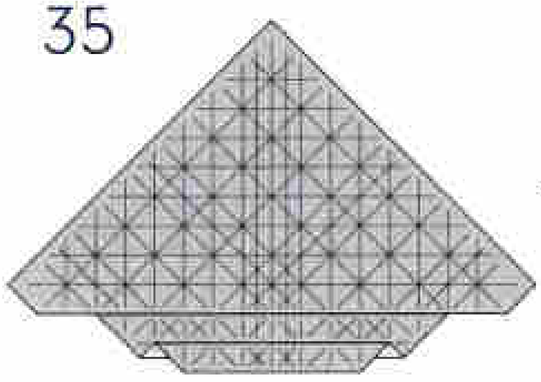
33



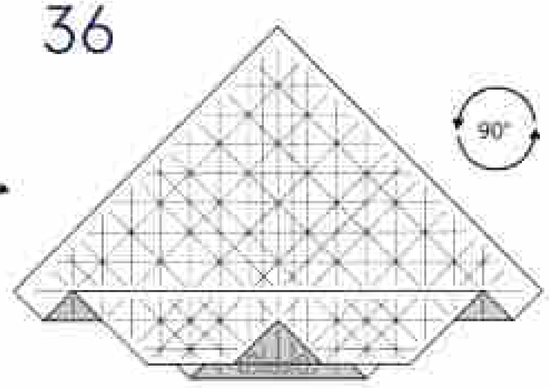
34



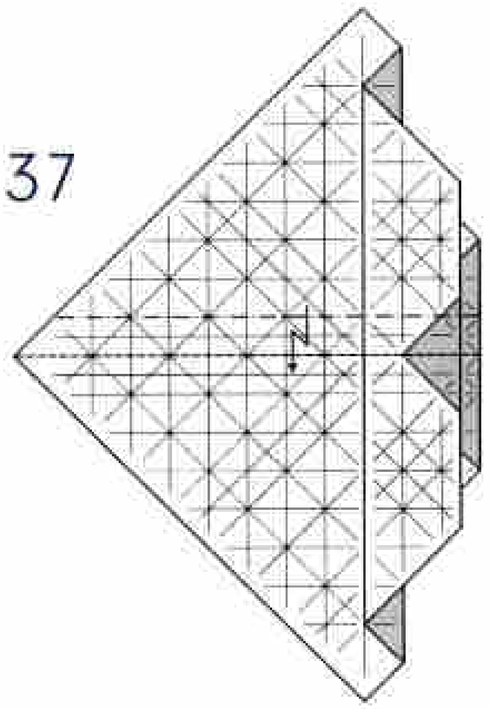
35



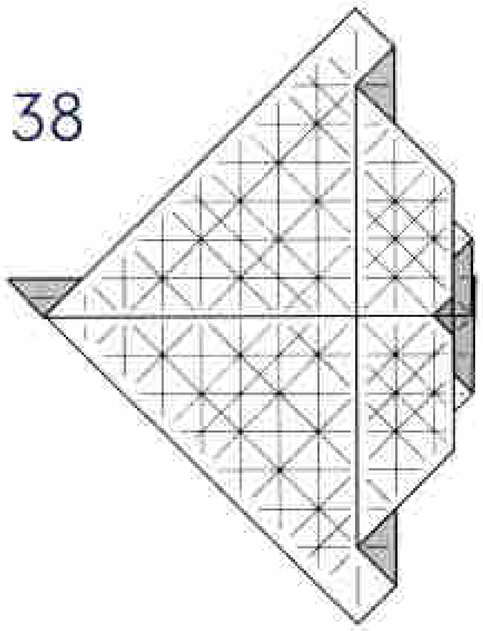
36



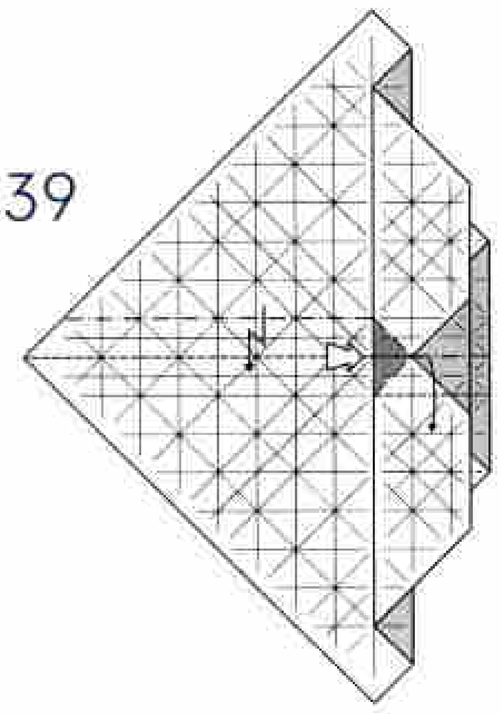
37



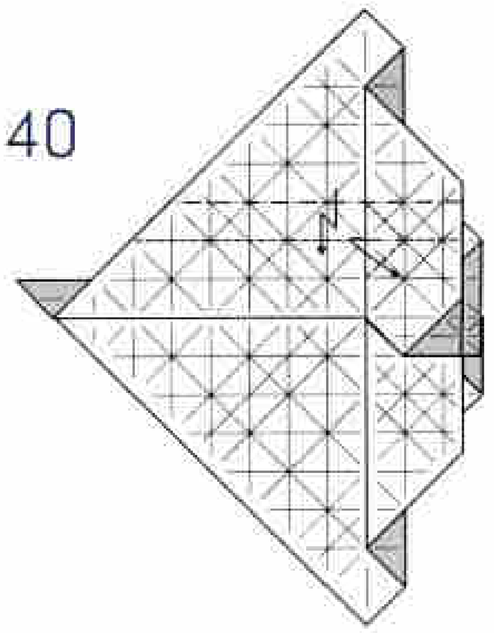
38



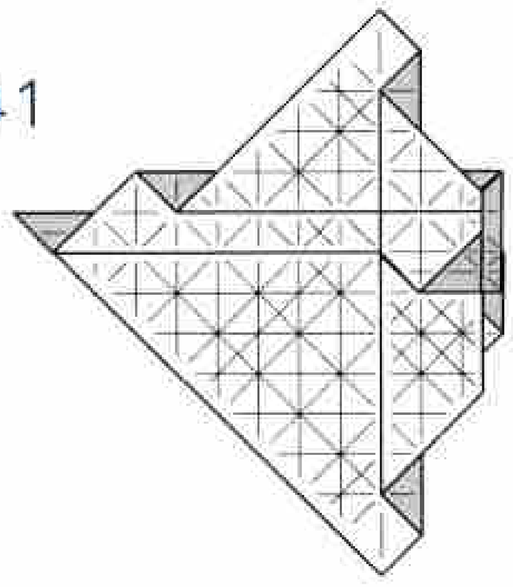
39



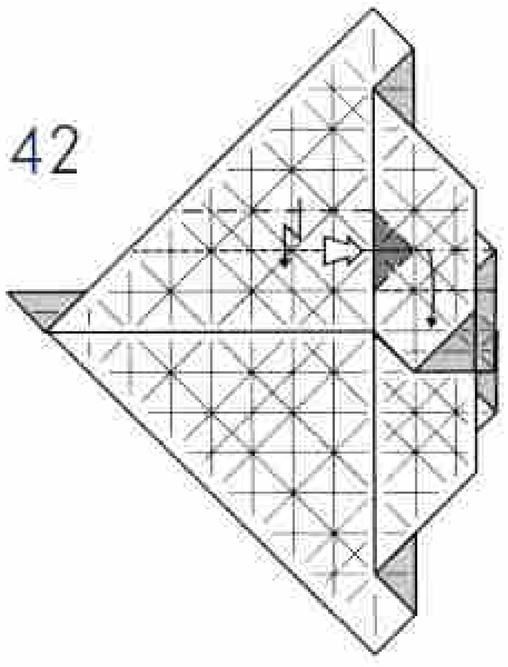
40



41



42



37
Pleat.

38
Unfold.

39
Pleat again but add squash.

40
Pleat and reverse fold.

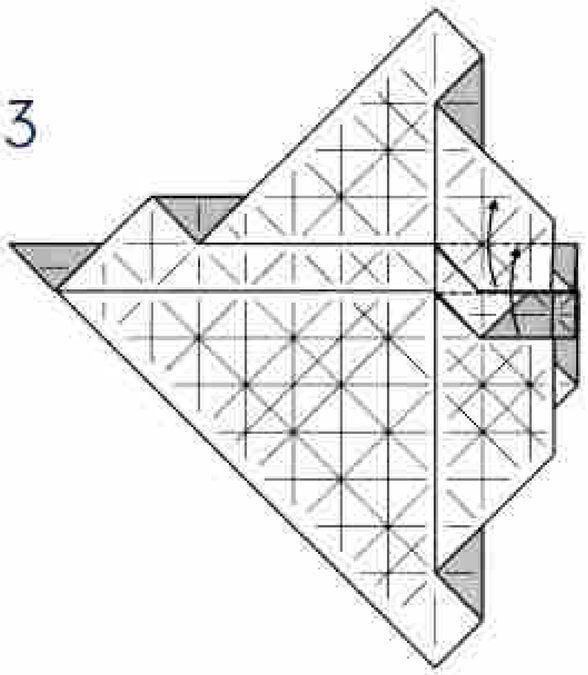
41
Unfold.

42
Pleat and add squash.

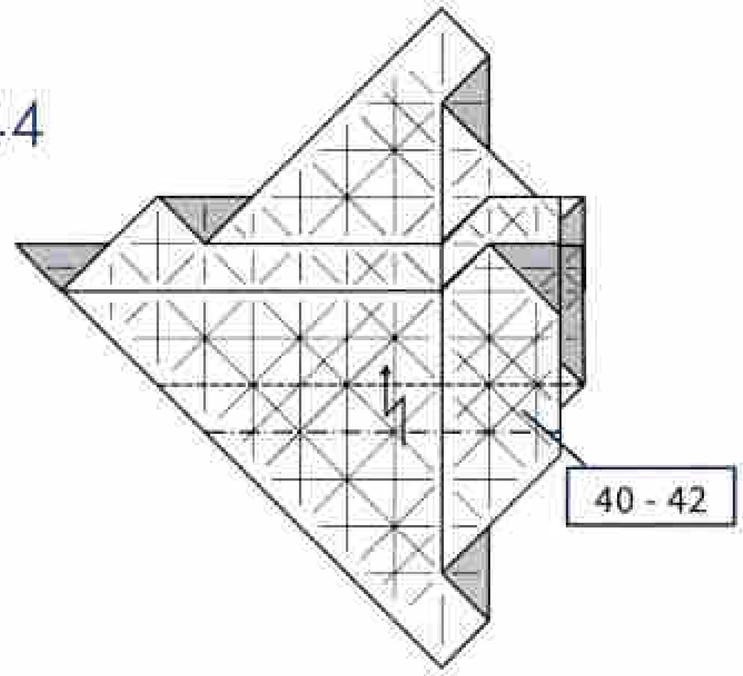
44
Repeat steps 40 to 42.

47
Squash.

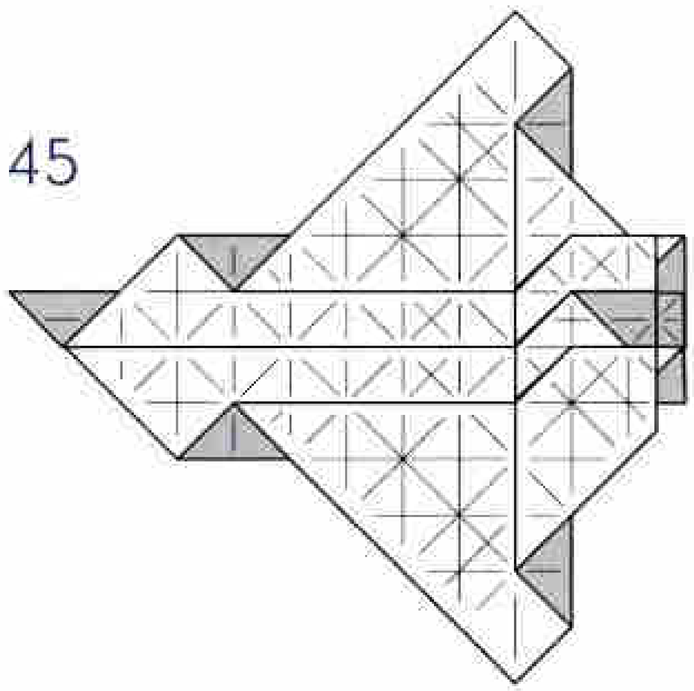
43



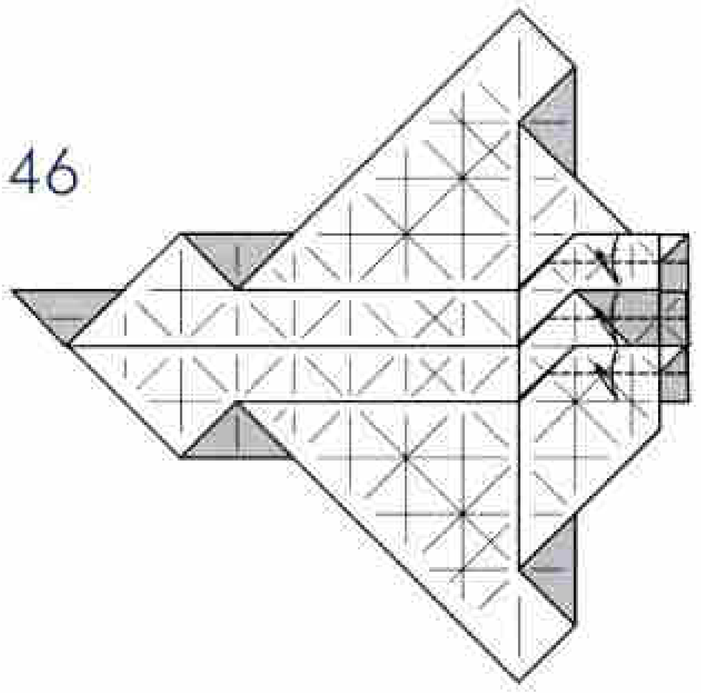
44



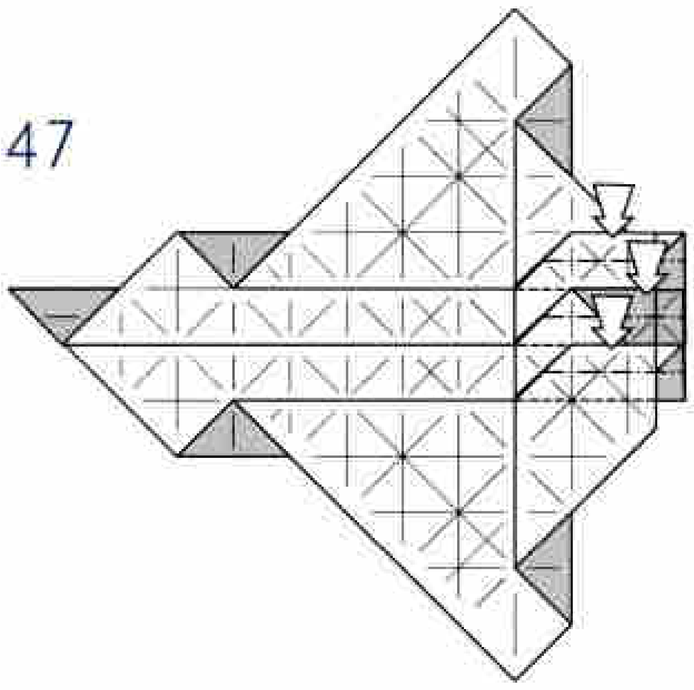
45



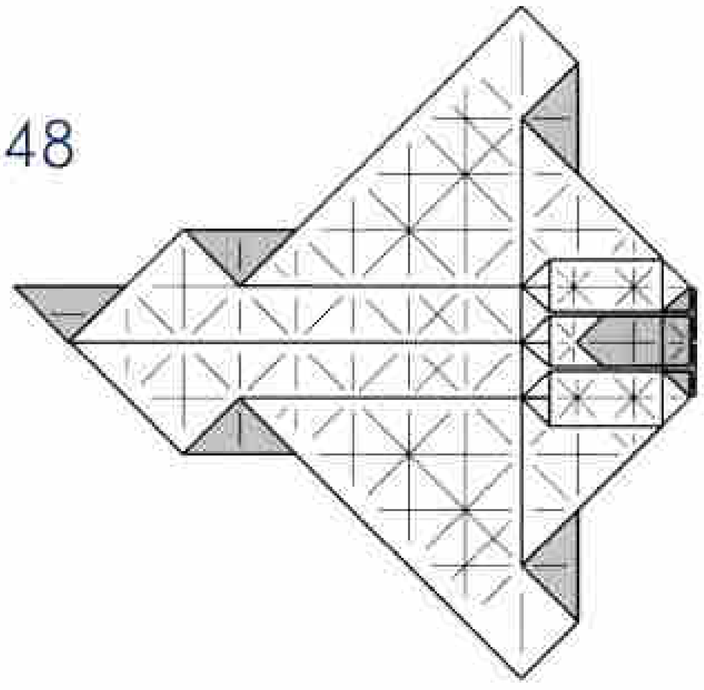
46



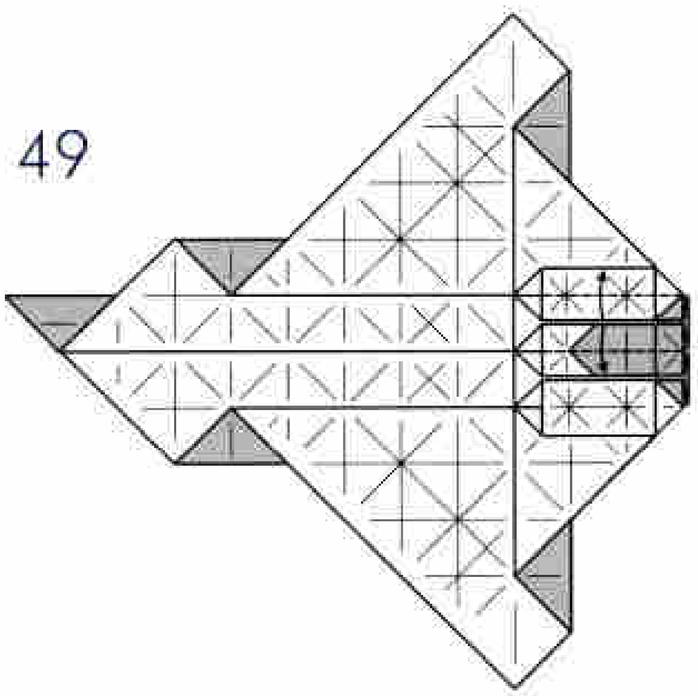
47



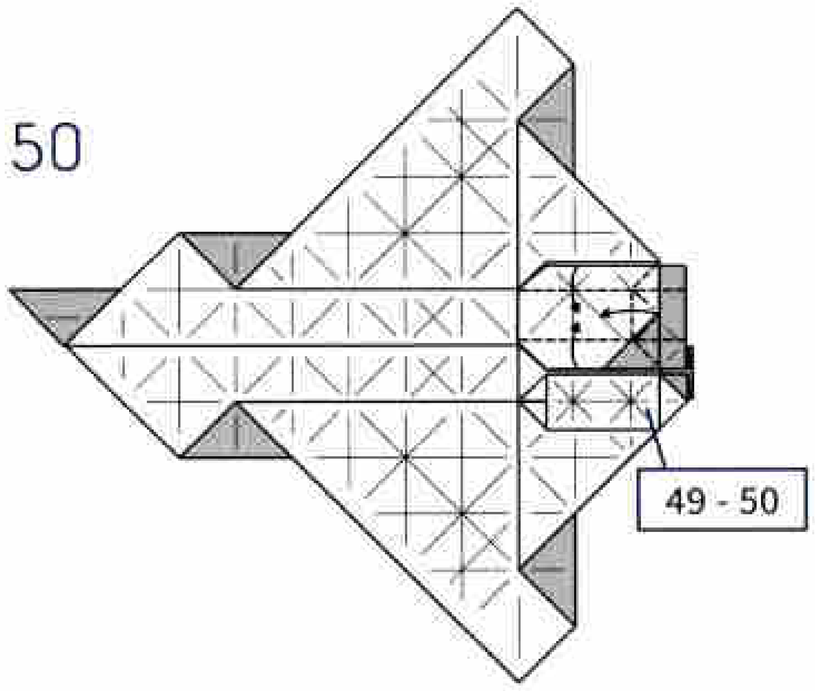
48



49



50



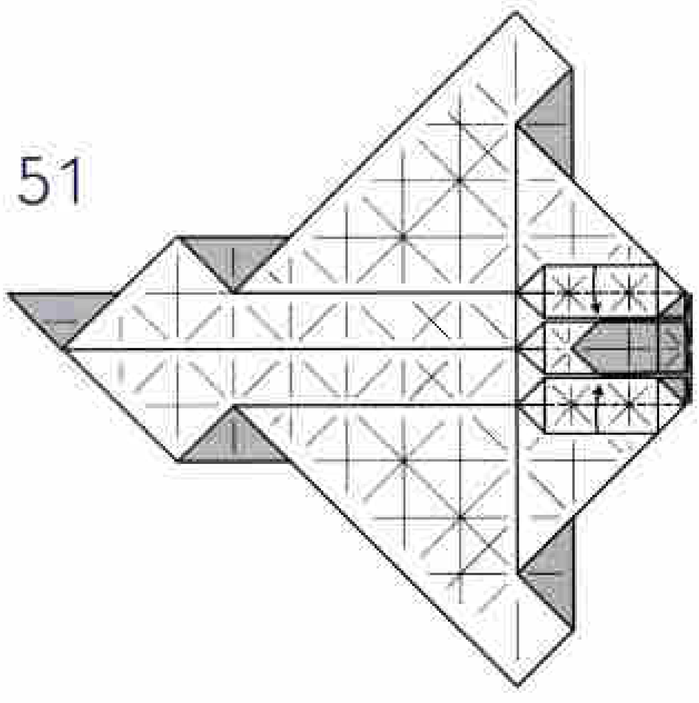
50
Close as shown. Repeat steps 49 and 50 on the other side.

52
Pleat and reverse fold.

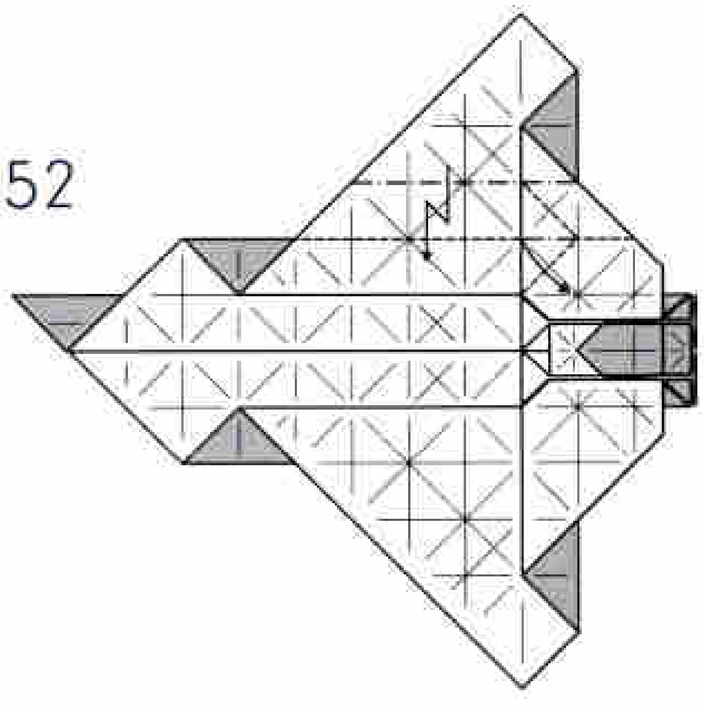
53
Unfold.

54
Pleat and add squash.

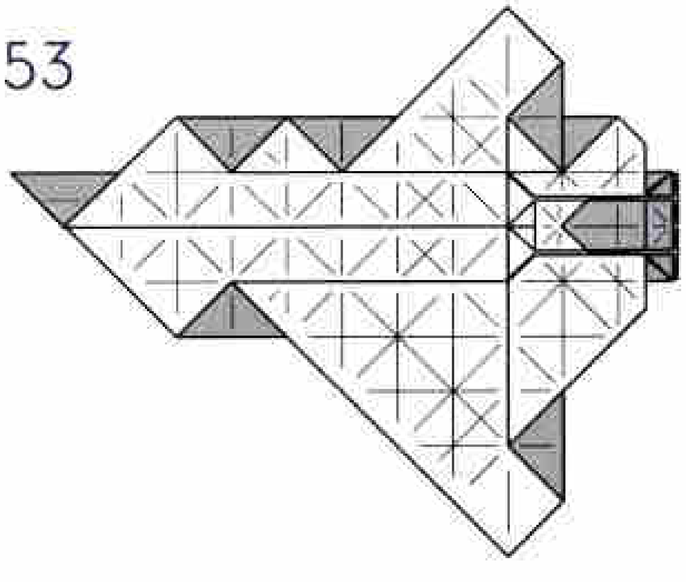
51



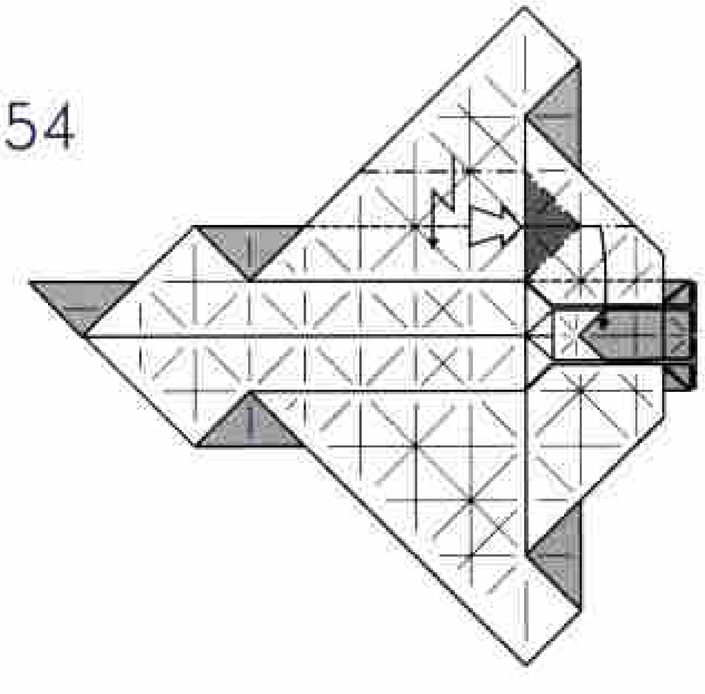
52



53



54

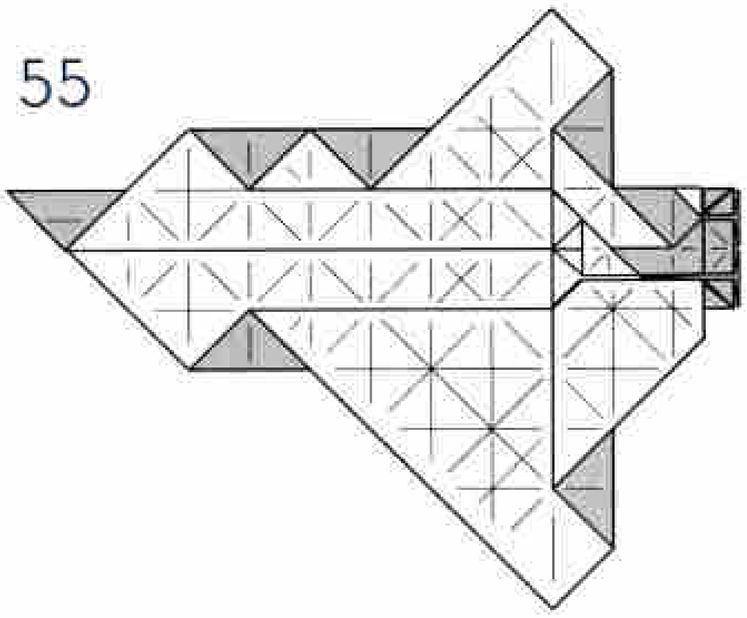


58
Inside reverse fold.

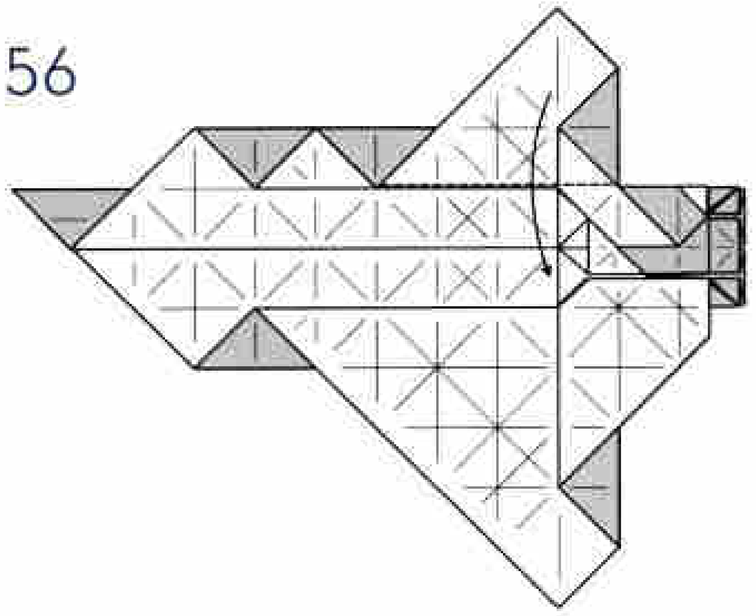
59
Valley fold. Tuck under.

60
Inside reverse fold.

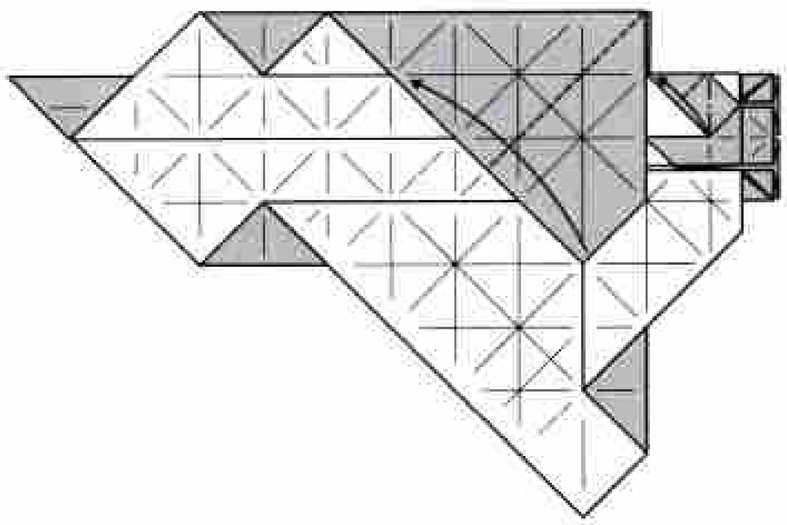
55



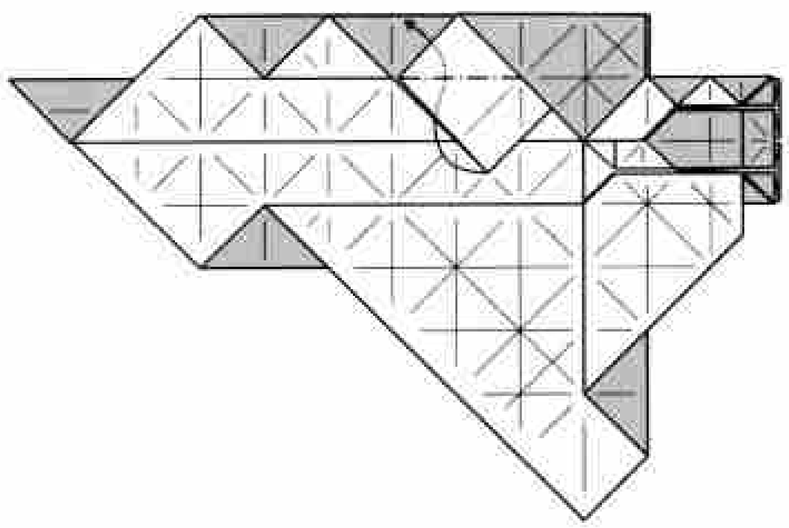
56



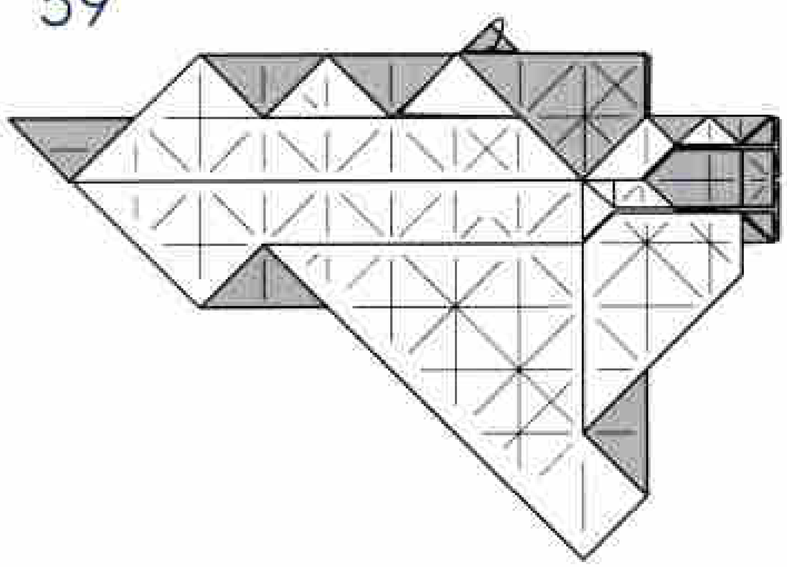
57



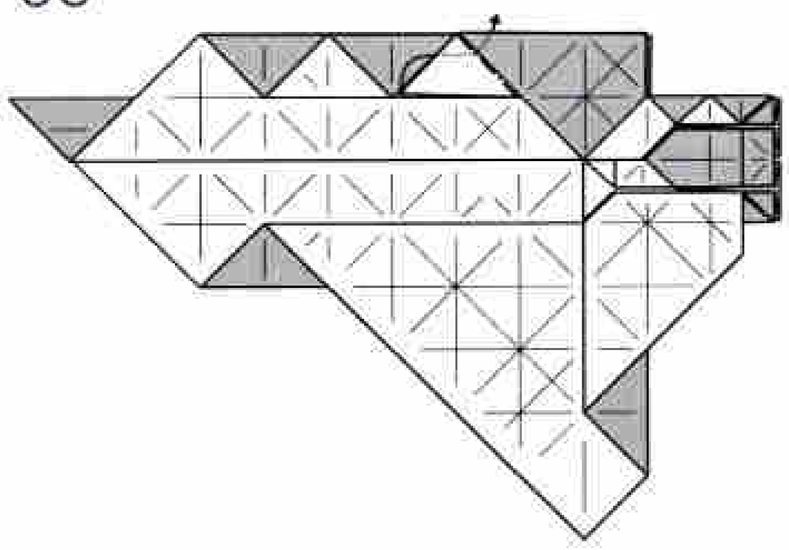
58



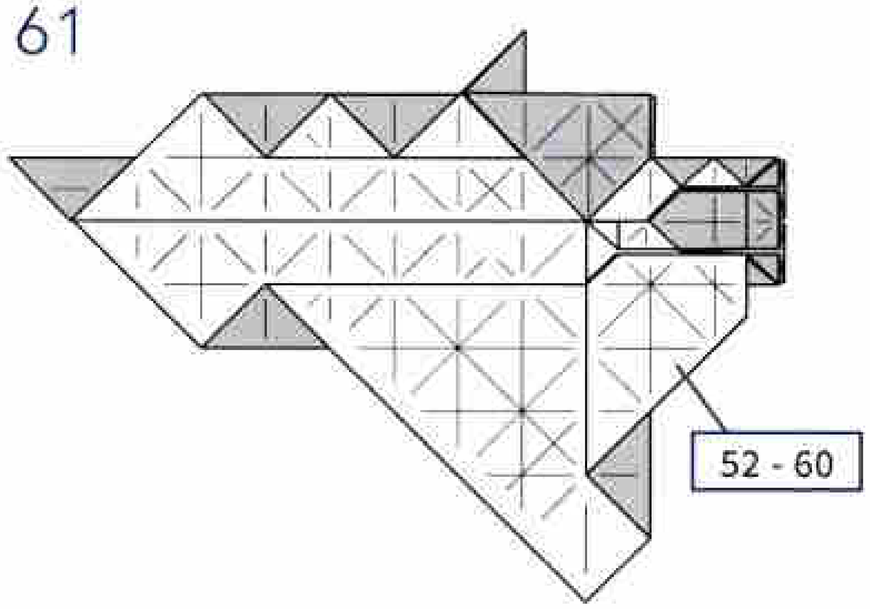
59



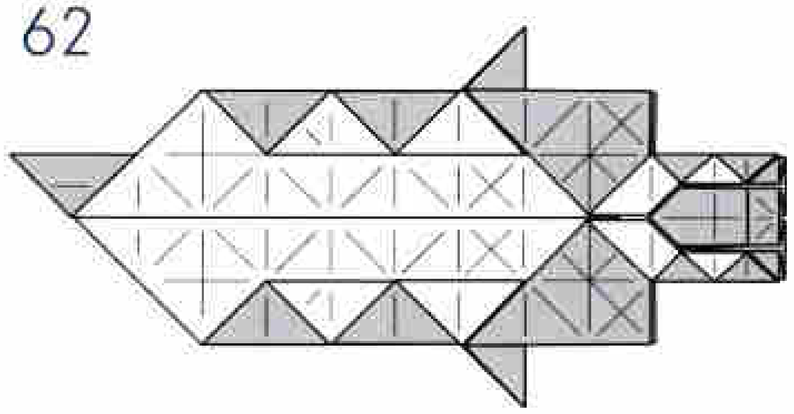
60



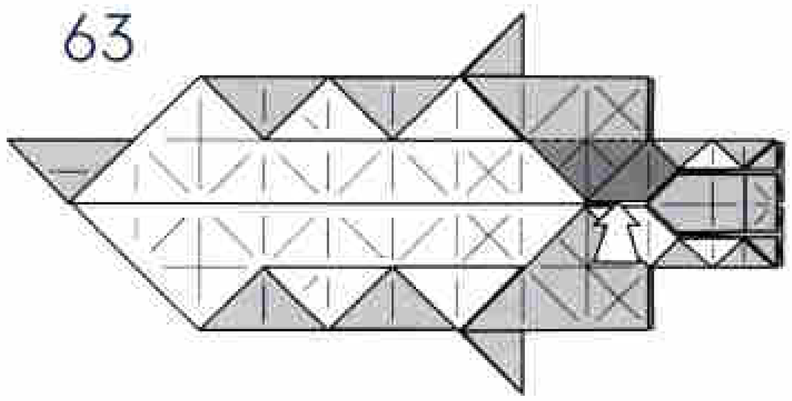
61



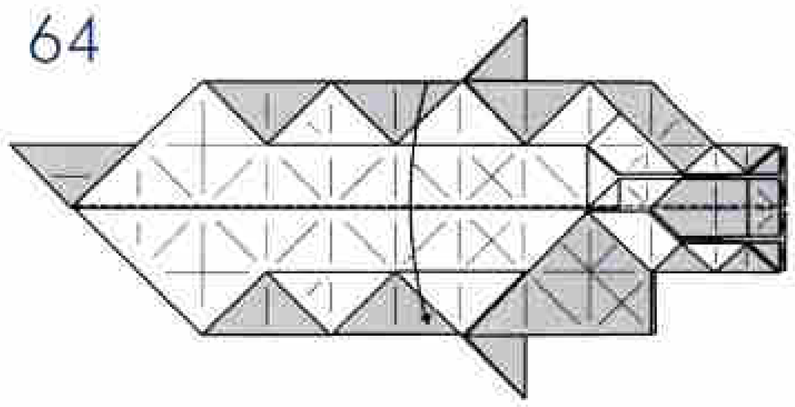
62



63



64



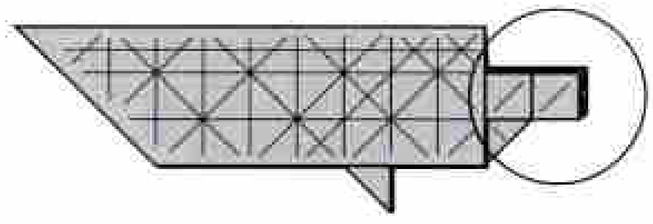
61
Repeat steps 52 to 60 on the other side.

63
Unsink only on one side.

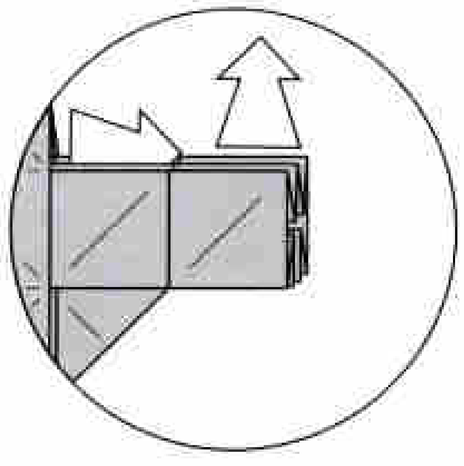
66
Push out the paper.

67
Repeat in the front.

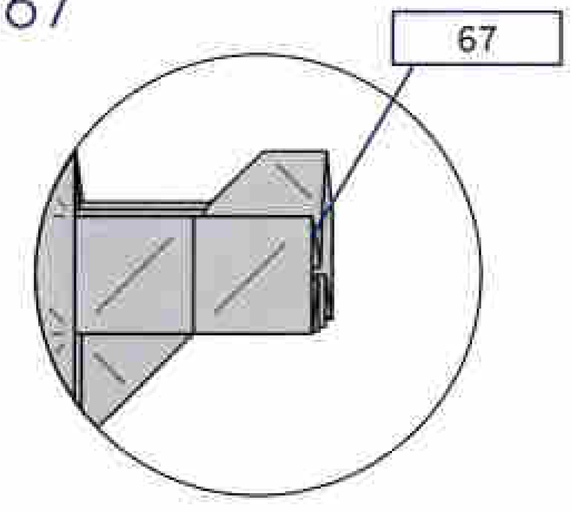
65



66



67

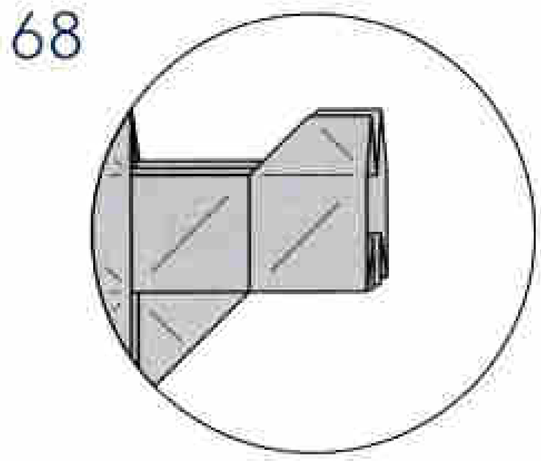


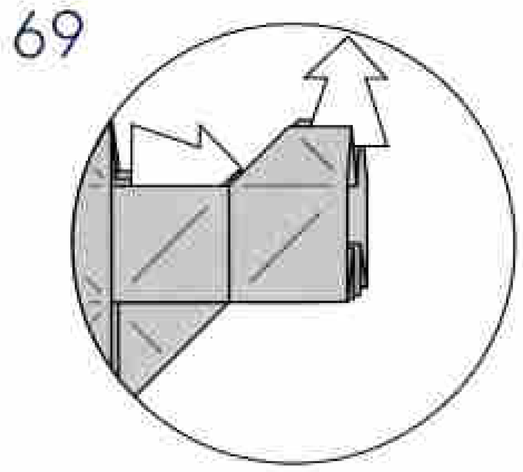
69
Push out the paper.

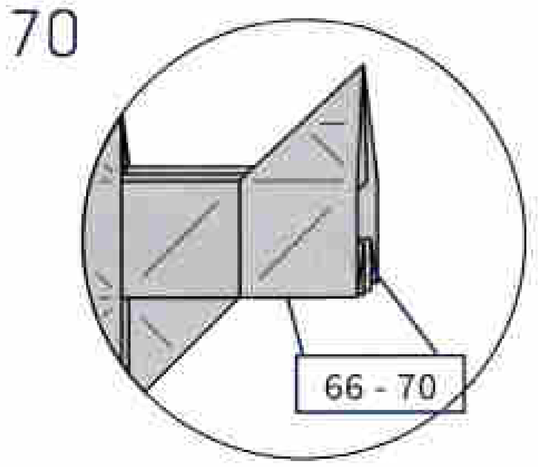
70
Repeat steps 66 to 70 twice on the bottom.

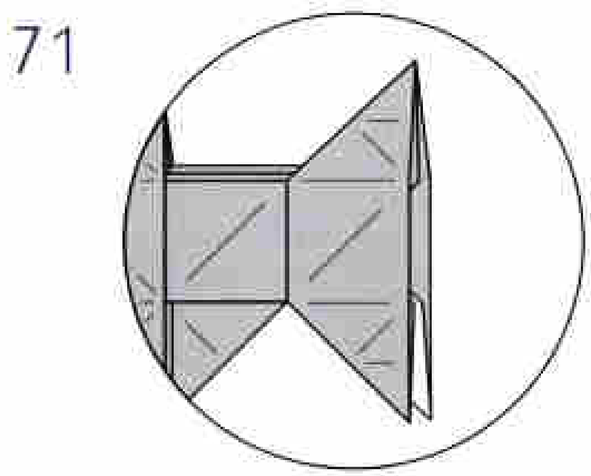
73
Crimp and unfold.

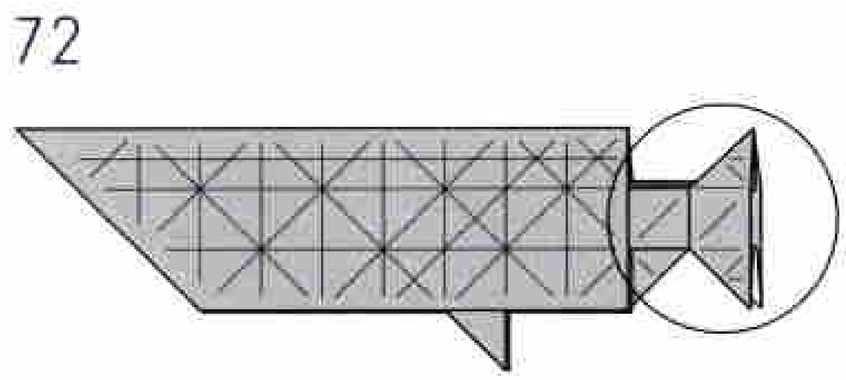
74
Squash.

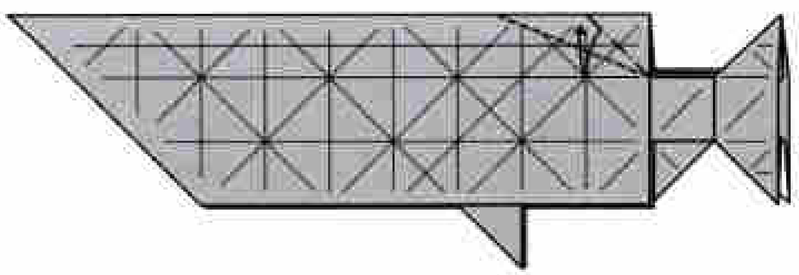


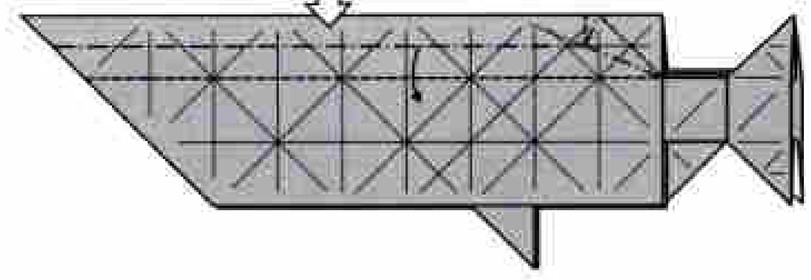




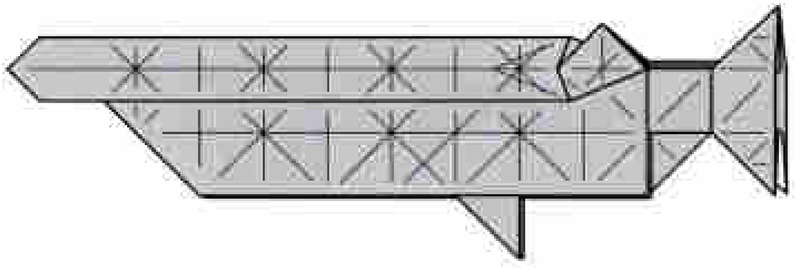




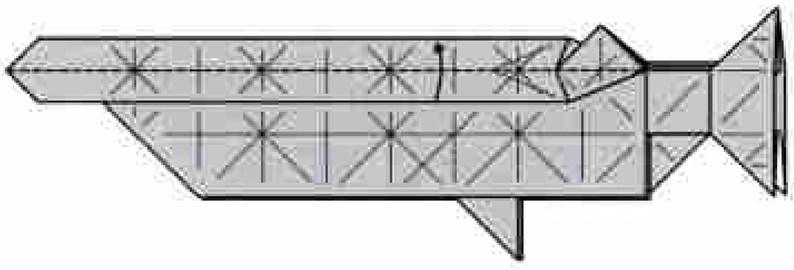




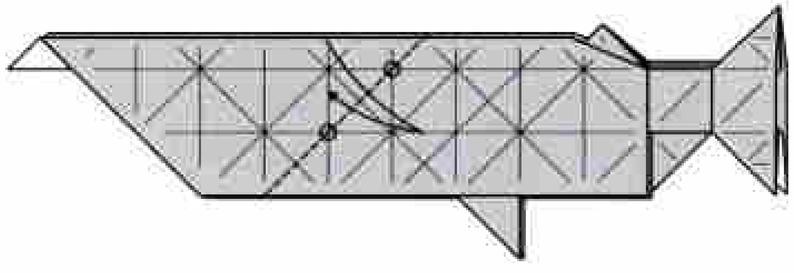
75



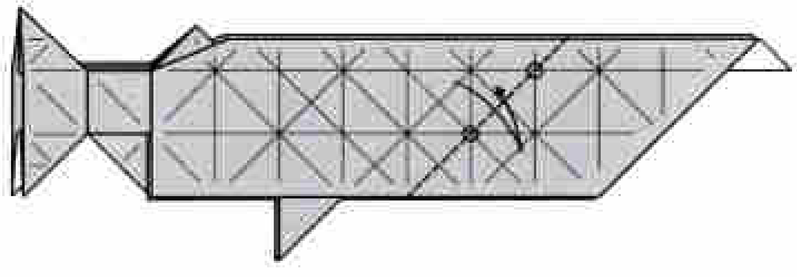
76



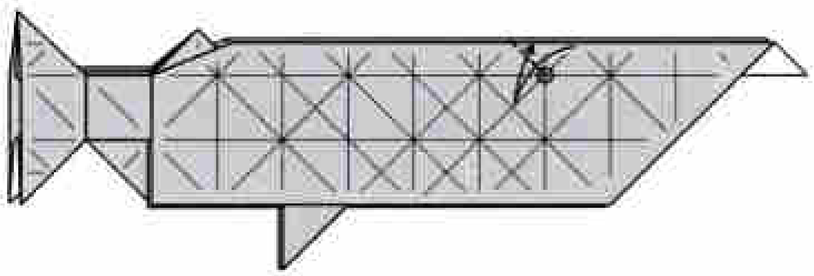
77



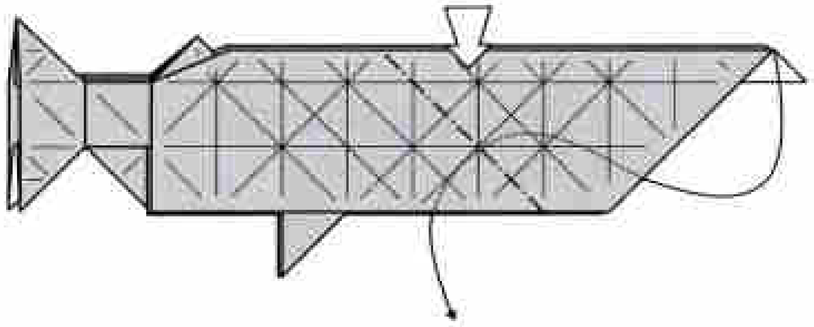
78



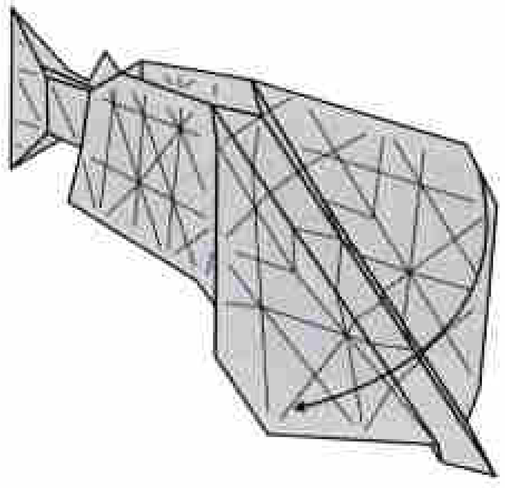
79



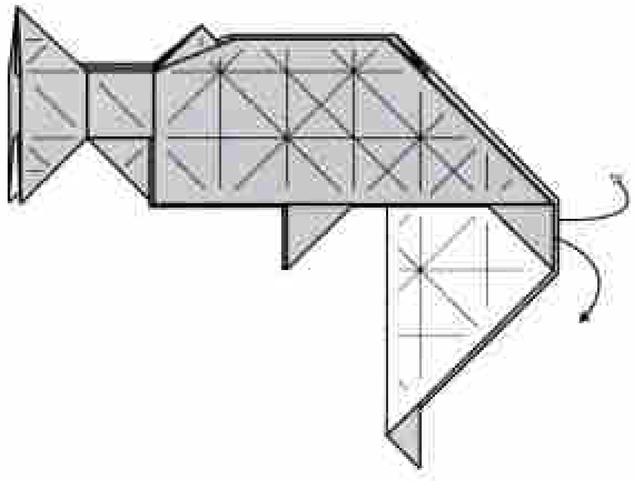
80



81



82



77
Fold and unfold.
Use references.
Flip over.

78
Fold and unfold.
Use references.

80
Inside reverse
fold.

81
In progress.

82
Inside reverse
fold completed.
Open the front.

83
Collapse as shown.

84
In progress.

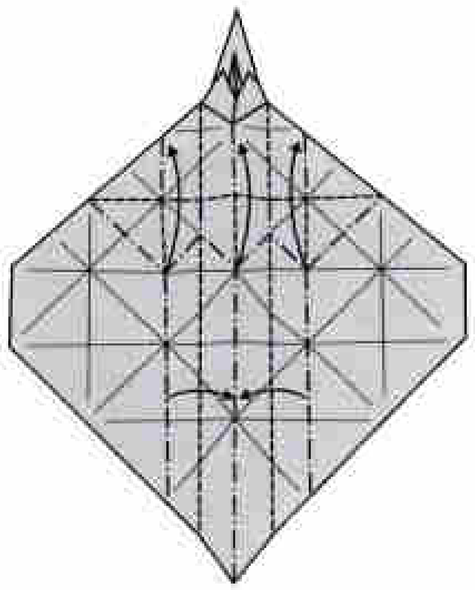
85
Pull out paper.

86
Reverse inner flap.

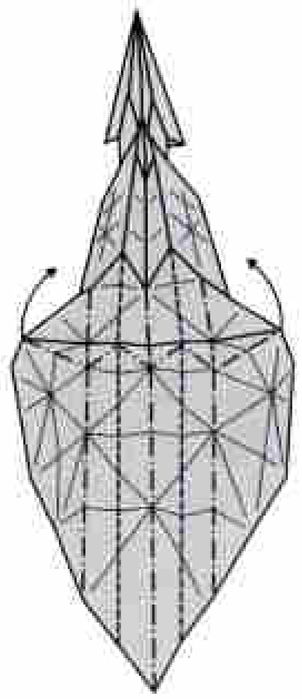
89
Inside reverse fold.

90
Collapse.

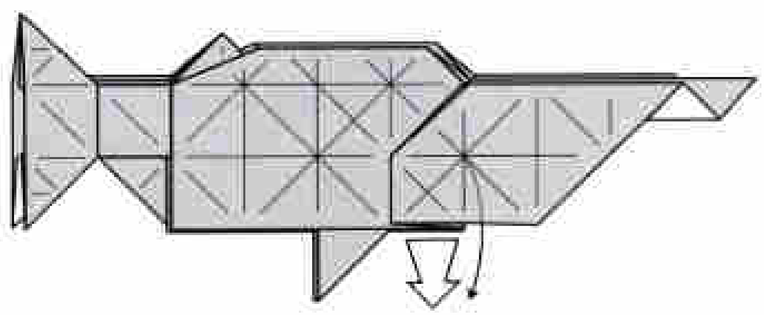
83



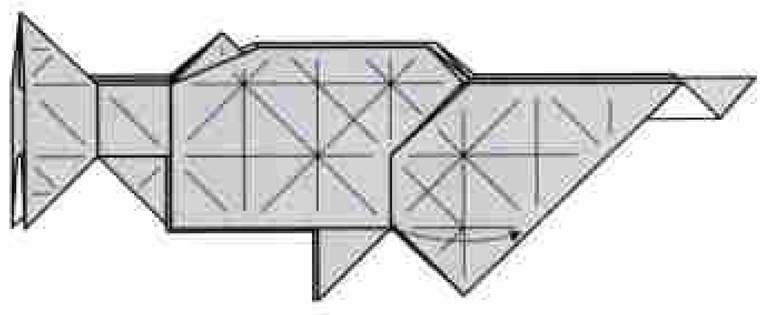
84



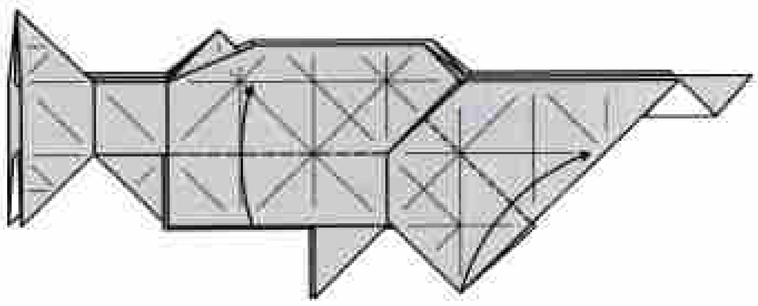
85



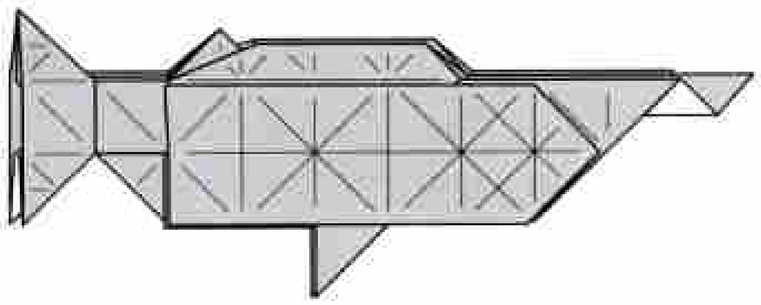
86



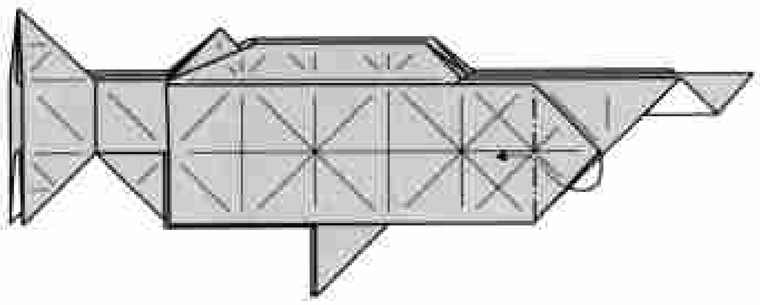
87



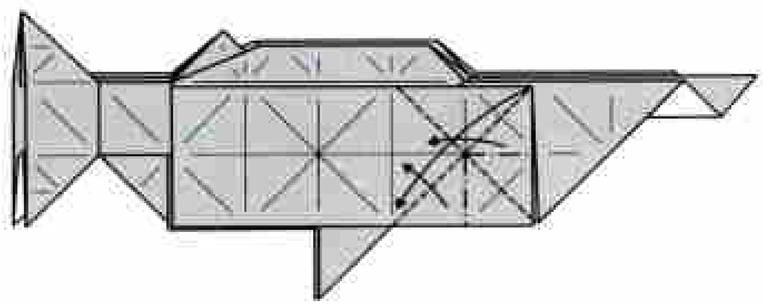
88



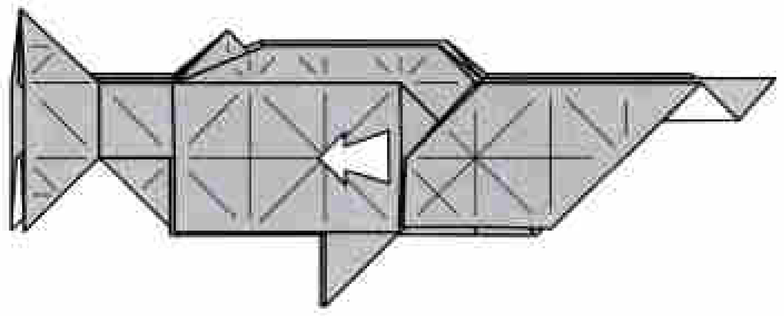
89



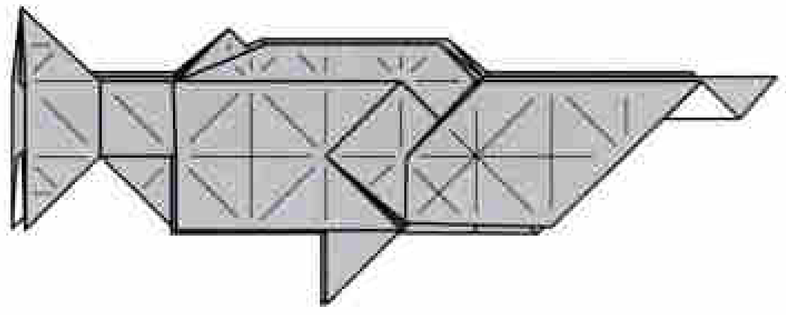
90



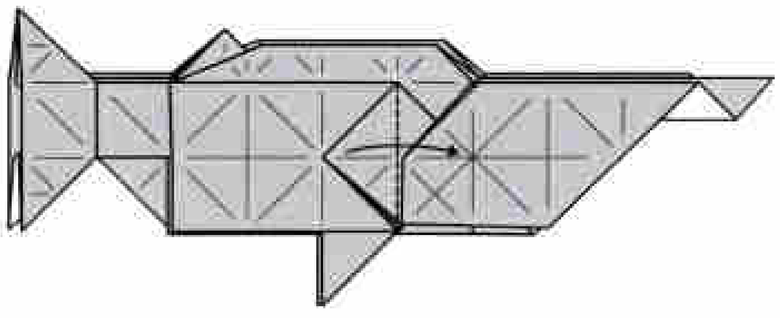
91



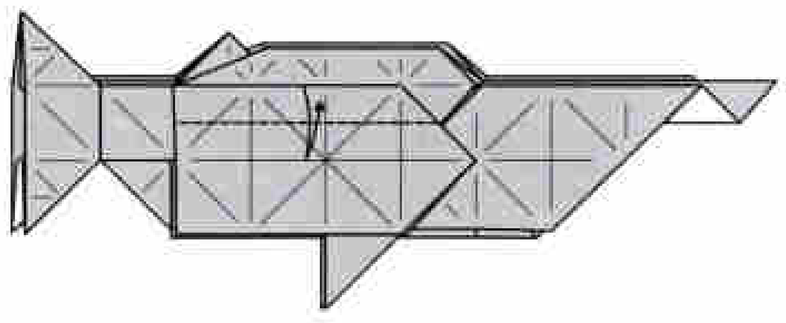
92



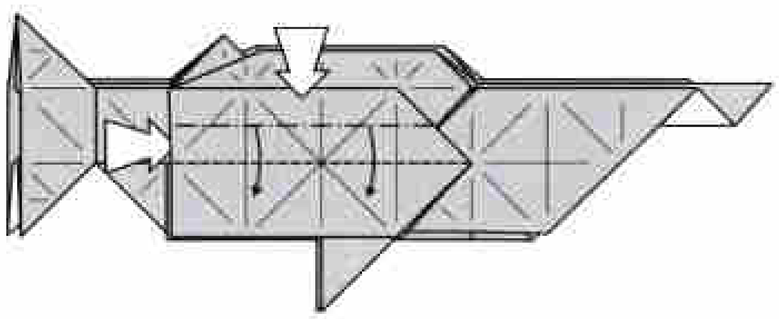
93



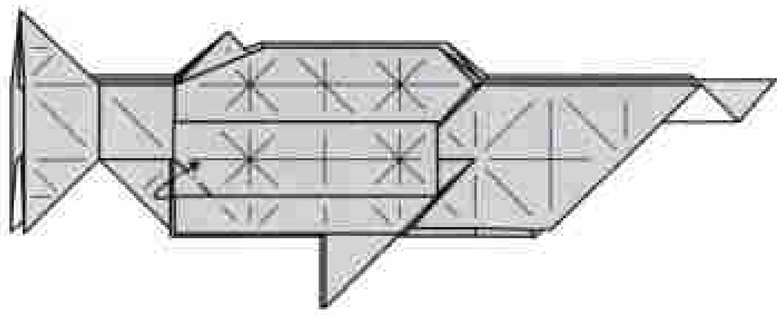
94



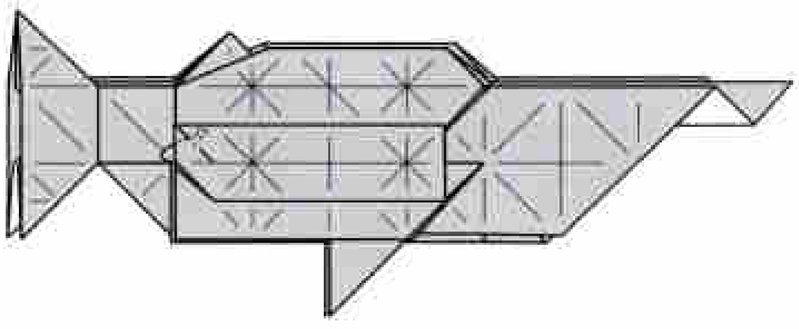
95



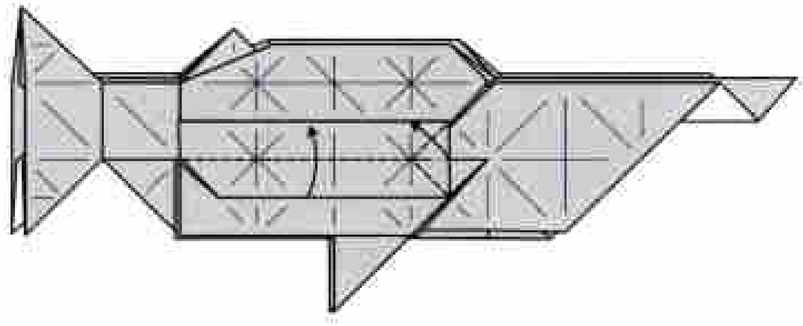
96



97



98



91
Unsink.

95
Squash.

96
Inside reverse fold.

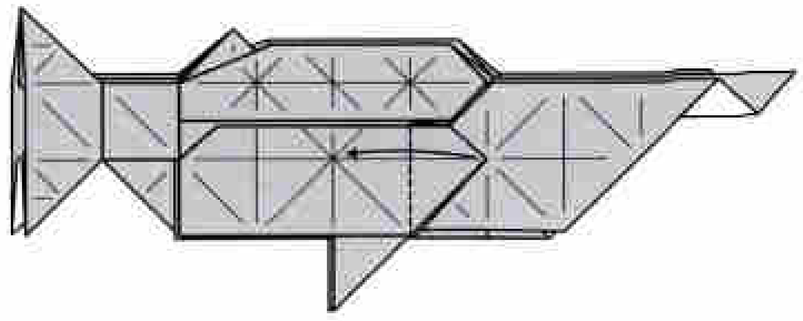
97
Mountain fold inner flap to lock.

100
Repeat steps 85
to 99 behind.

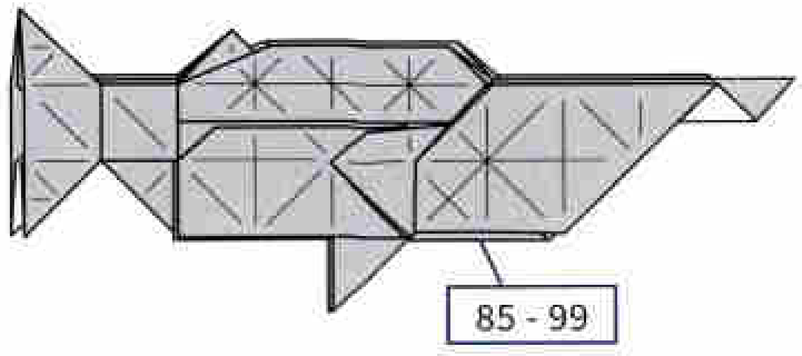
112
Reverse.

115
Reverse fold.

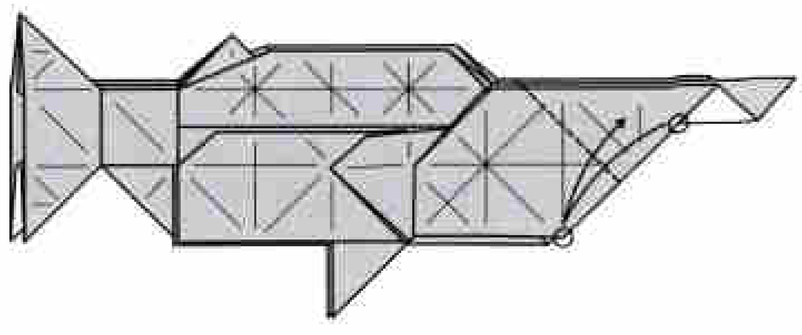
99



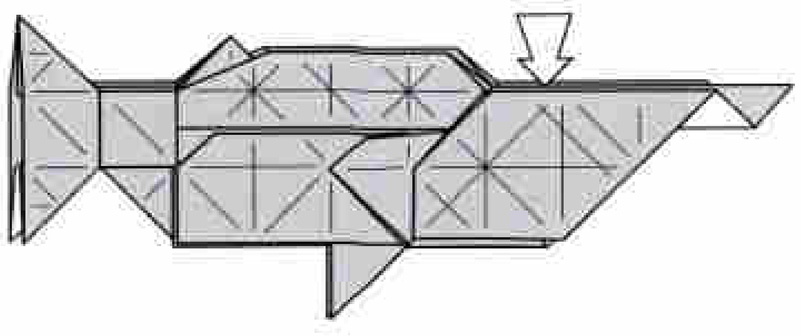
100



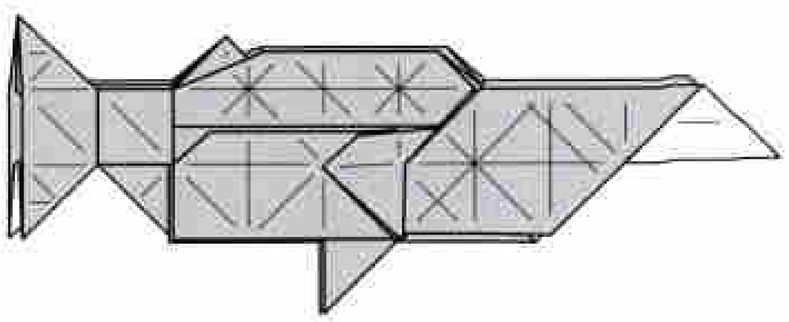
111



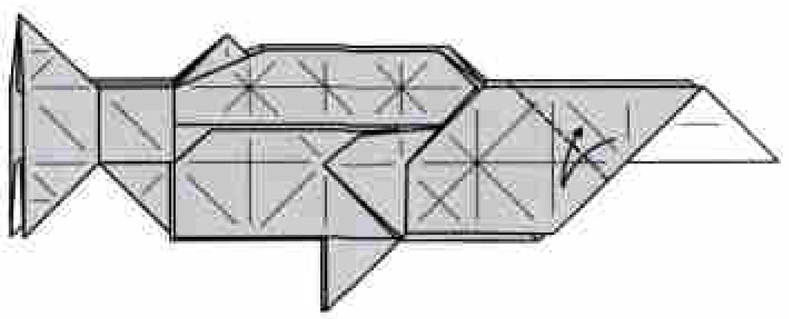
112



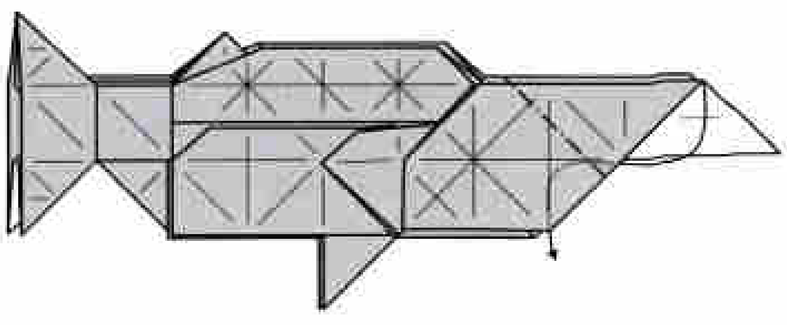
113



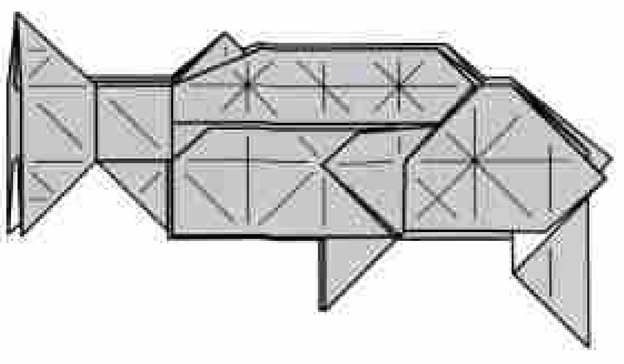
114



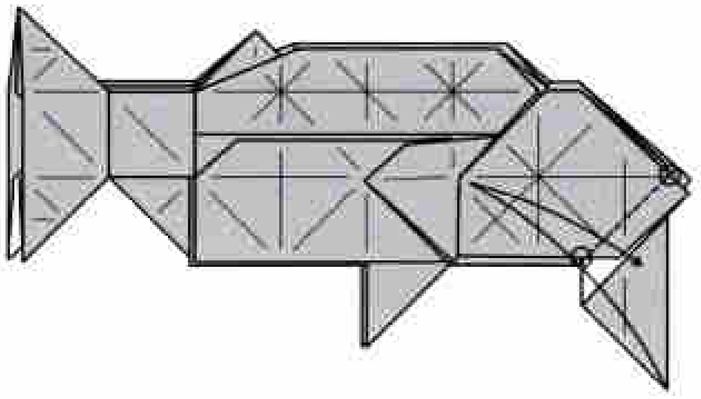
115



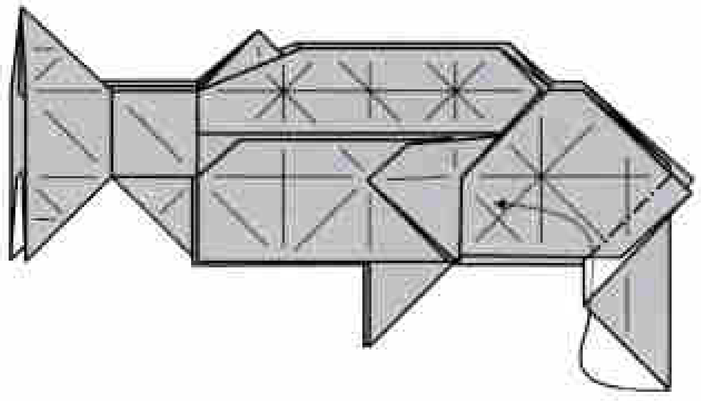
116



117



118

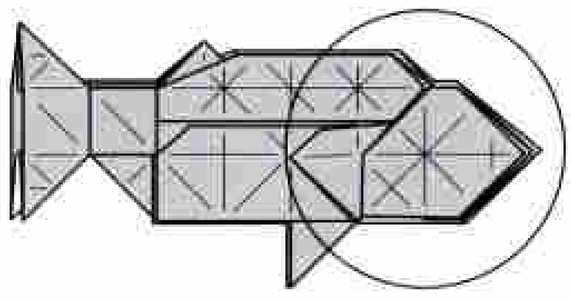


118
Reverse fold.

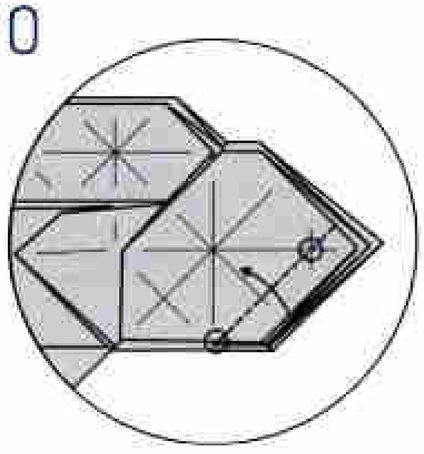
120
Valley fold.
Squash the
bottom.

123
Inside reverse
fold.

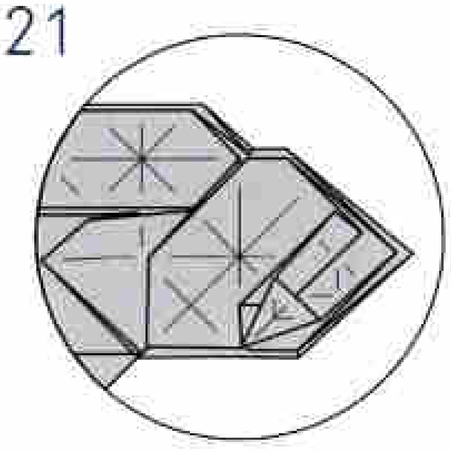
119



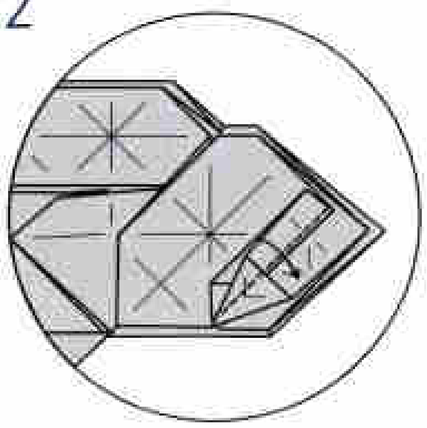
120



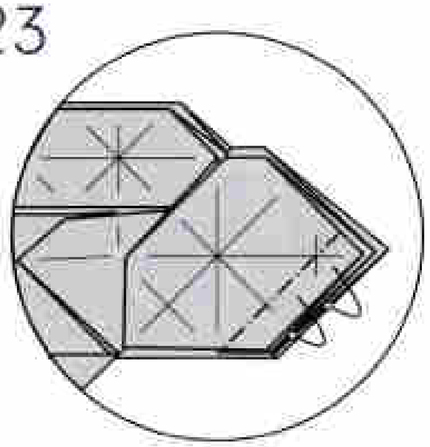
121



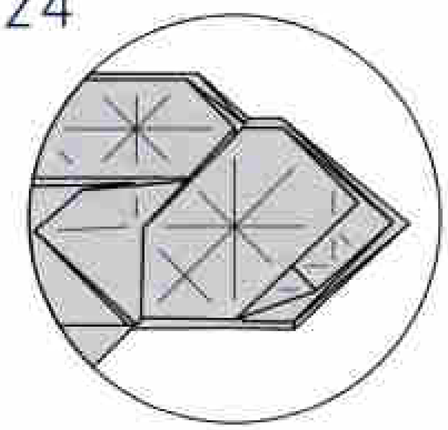
122



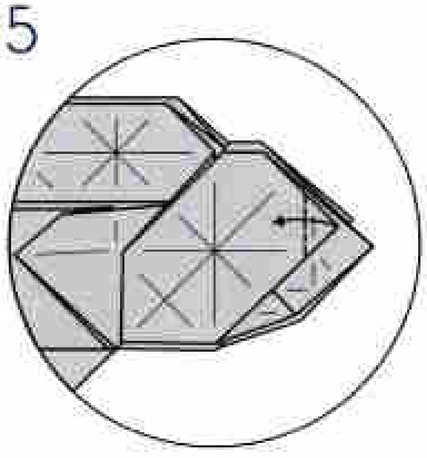
123



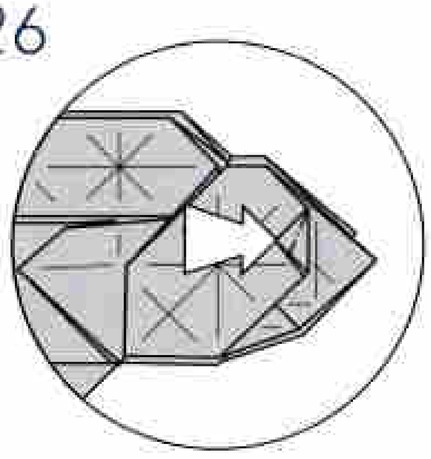
124



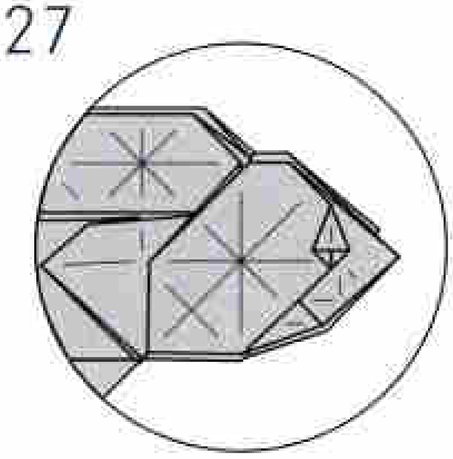
125



126



127



128
Shape. Repeat steps 120 to 128 behind.

130
Reverse fold the inner flap to create the lower jaw.

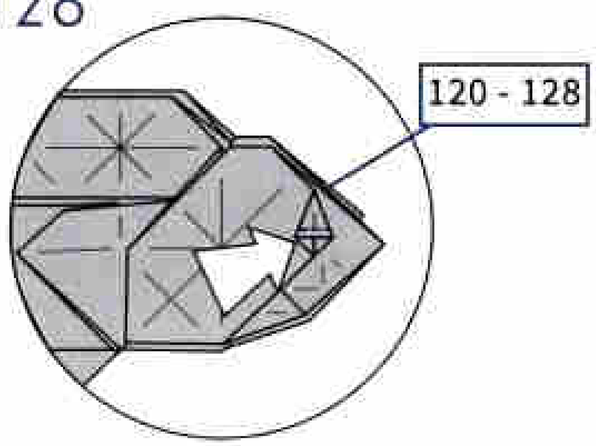
133
Closed sink.

134
Valley fold into pocket.

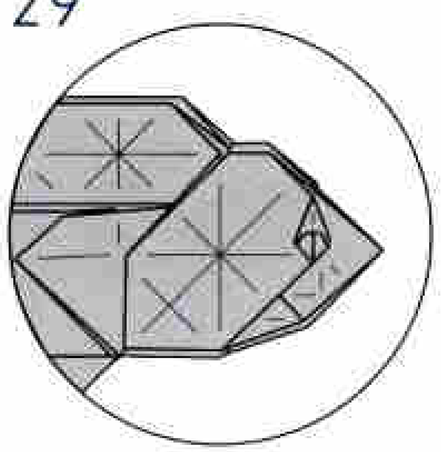
135
Fold corners inside.

136
Fold and unfold. Repeat behind.

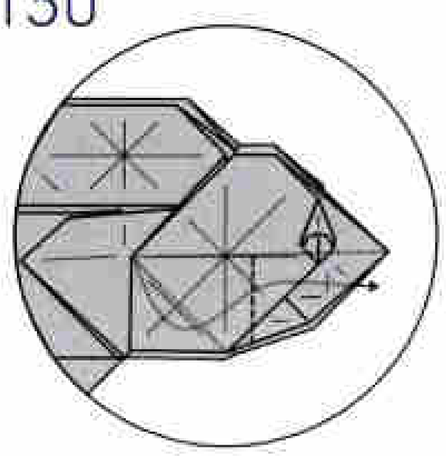
128



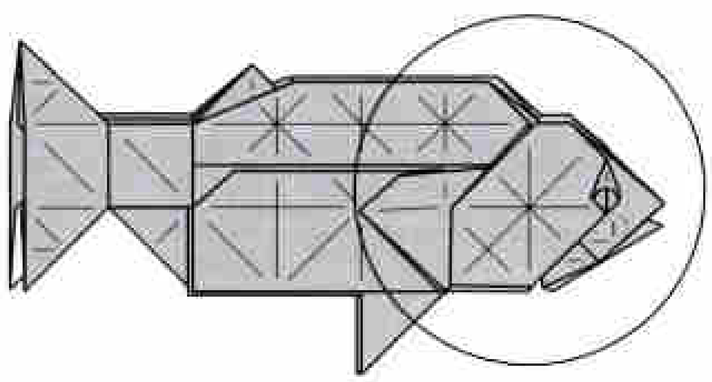
129



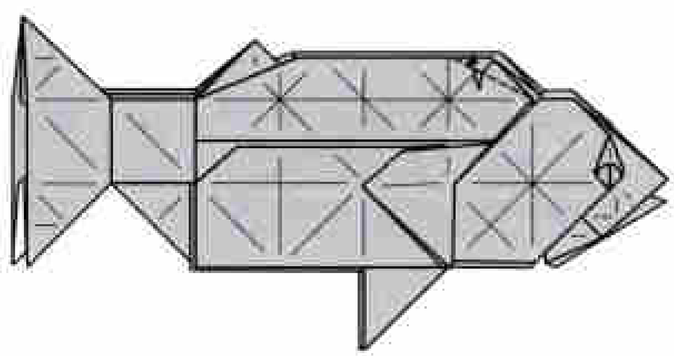
130



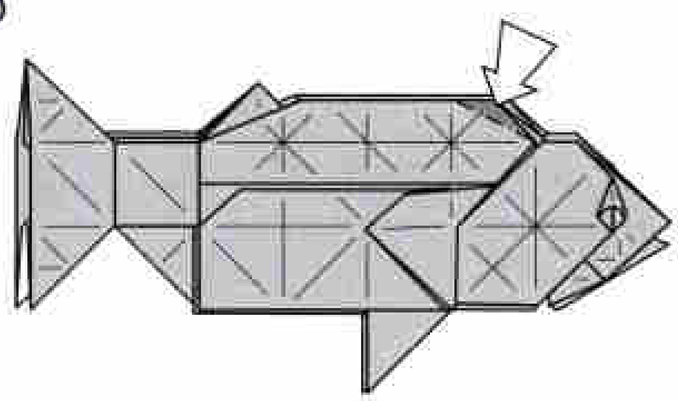
131



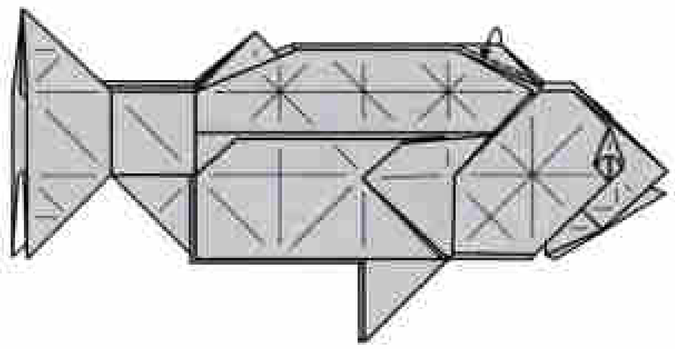
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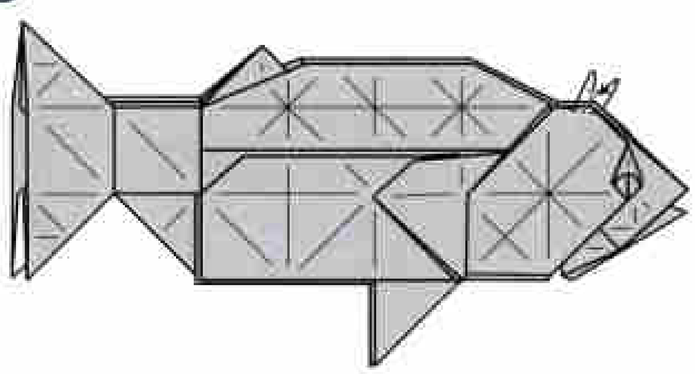
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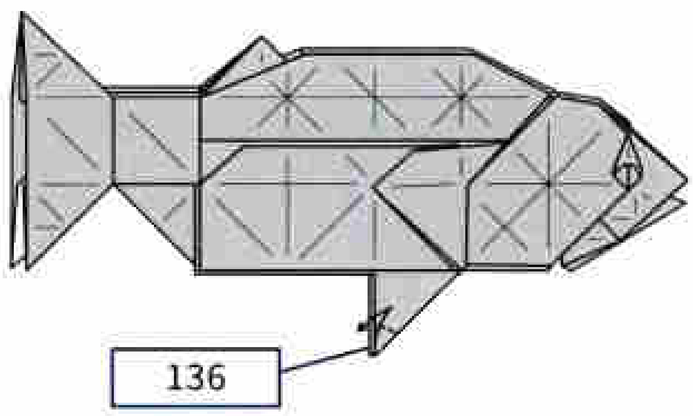
134



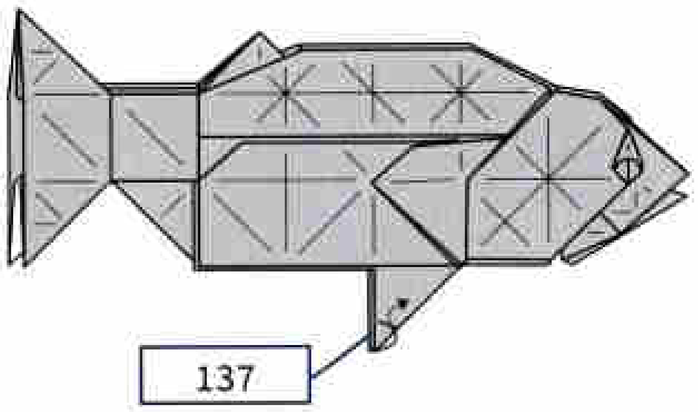
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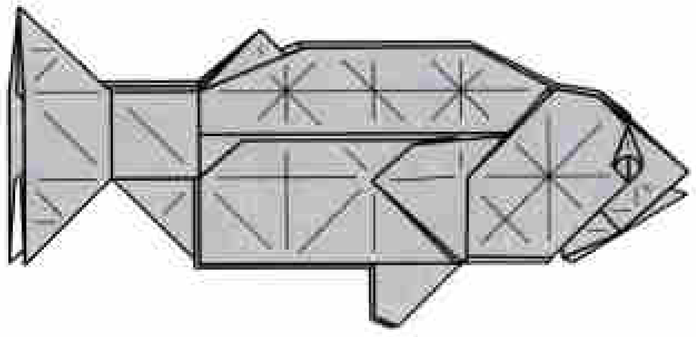
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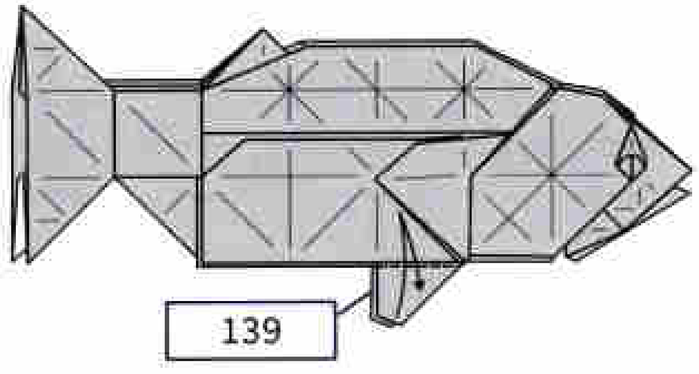
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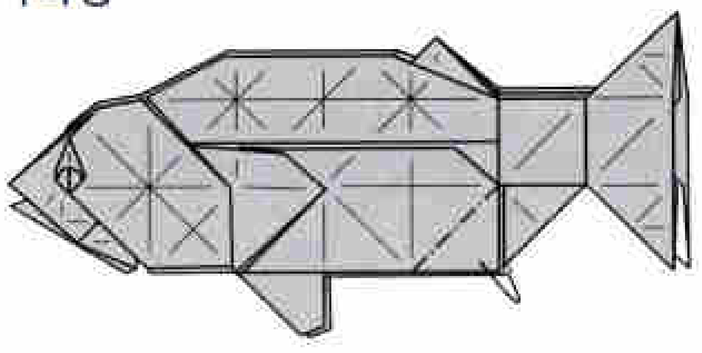
138



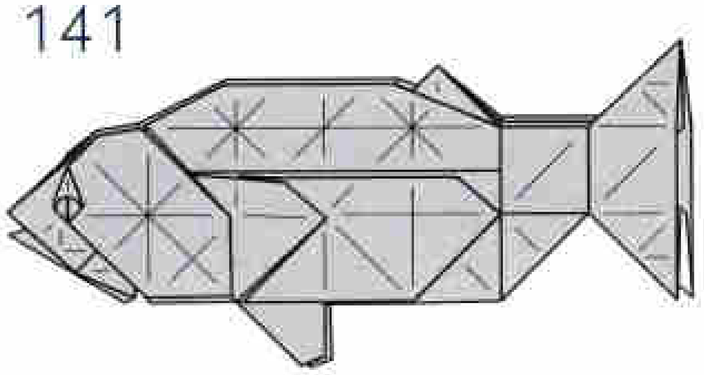
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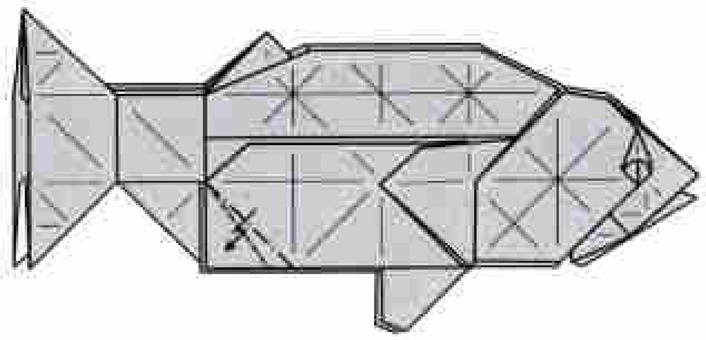
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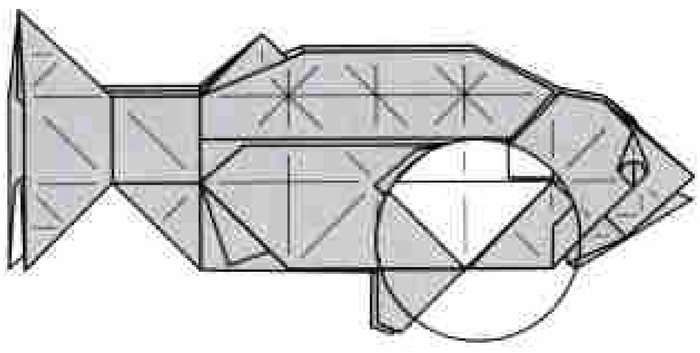
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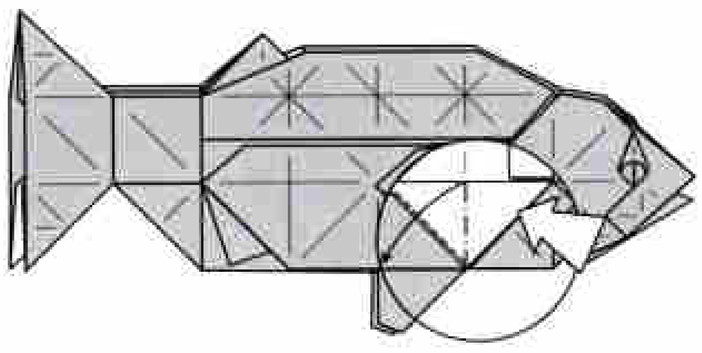
142



143



144



137
Inside reverse fold corner. Repeat behind.

139
Fold and unfold. Repeat behind. Flip over.

140
Mountain fold.

142
Crimp.

143
Inside view.

144
Squash.

145
Valley fold.

146
Tuck inside pocket.

147
Tuck completed. Only repeat steps 143 to 145 on the other side.

148
Fold flap out.

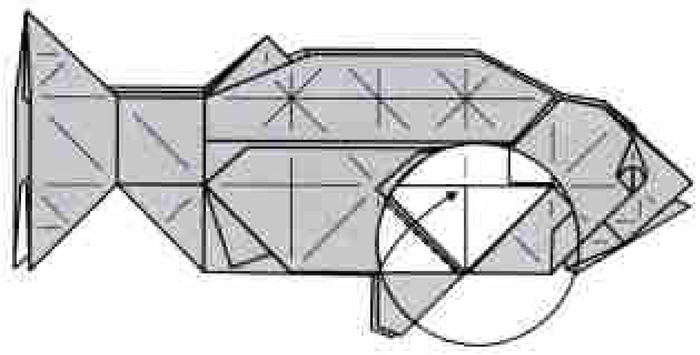
149
Tuck inside the opposite pocket.

150
Tuck inside pocket.

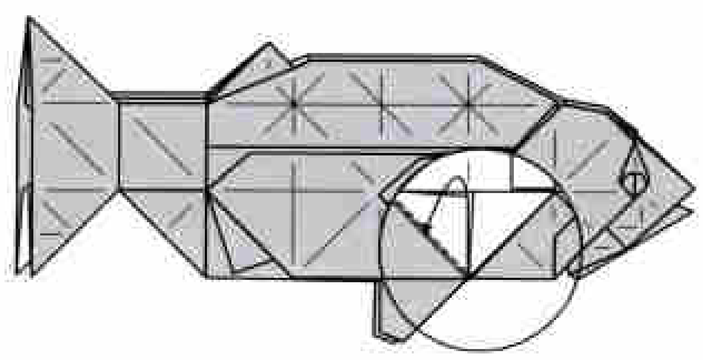
151
Insert the free flap into the pocket of step 146.

152
Shape.

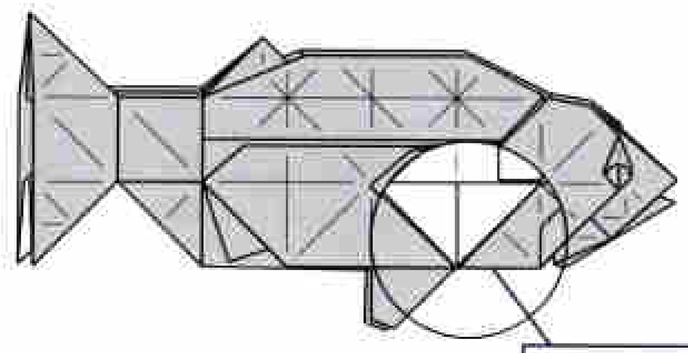
145



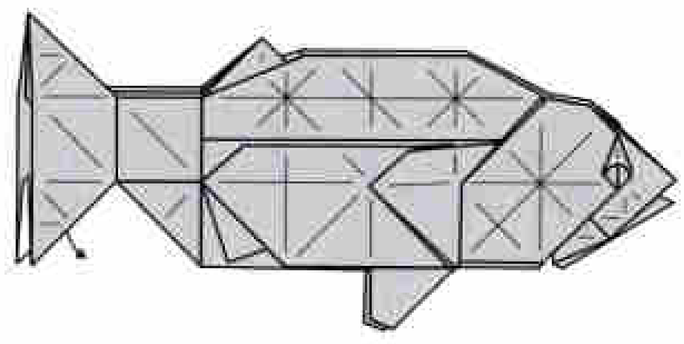
146



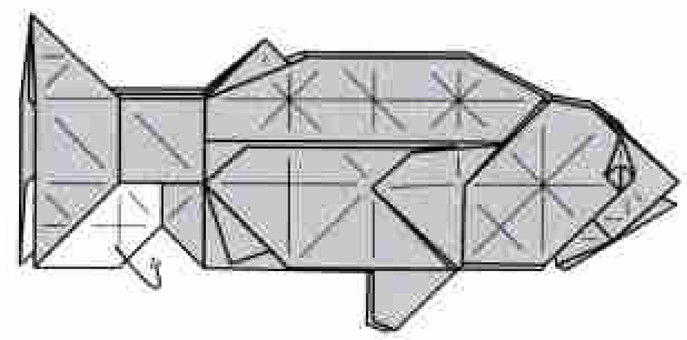
147



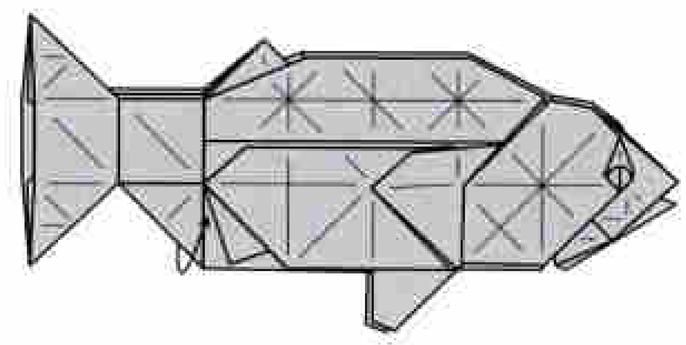
148



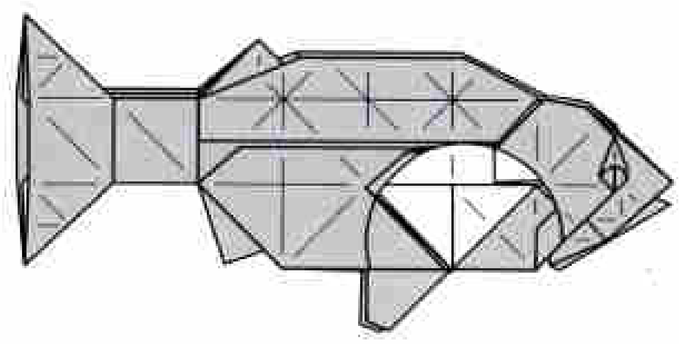
149



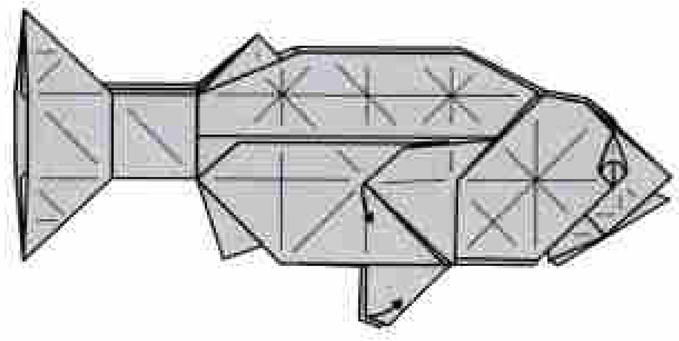
150



151



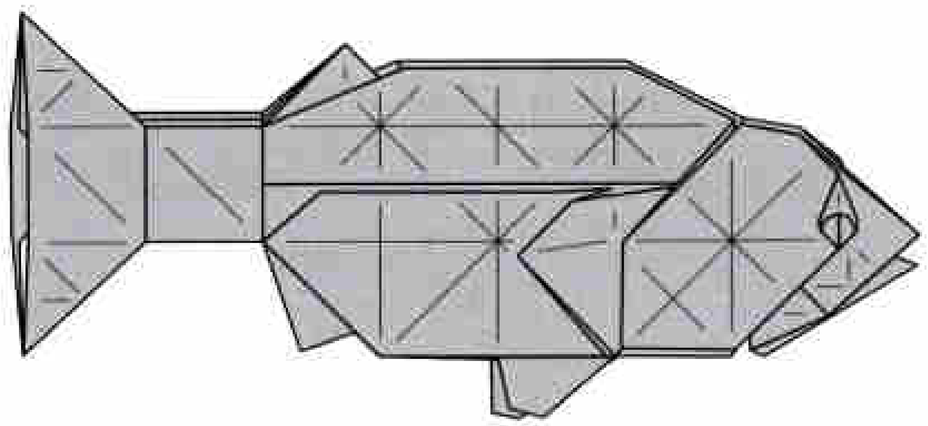
152



153

Giant sea bass completed.

153

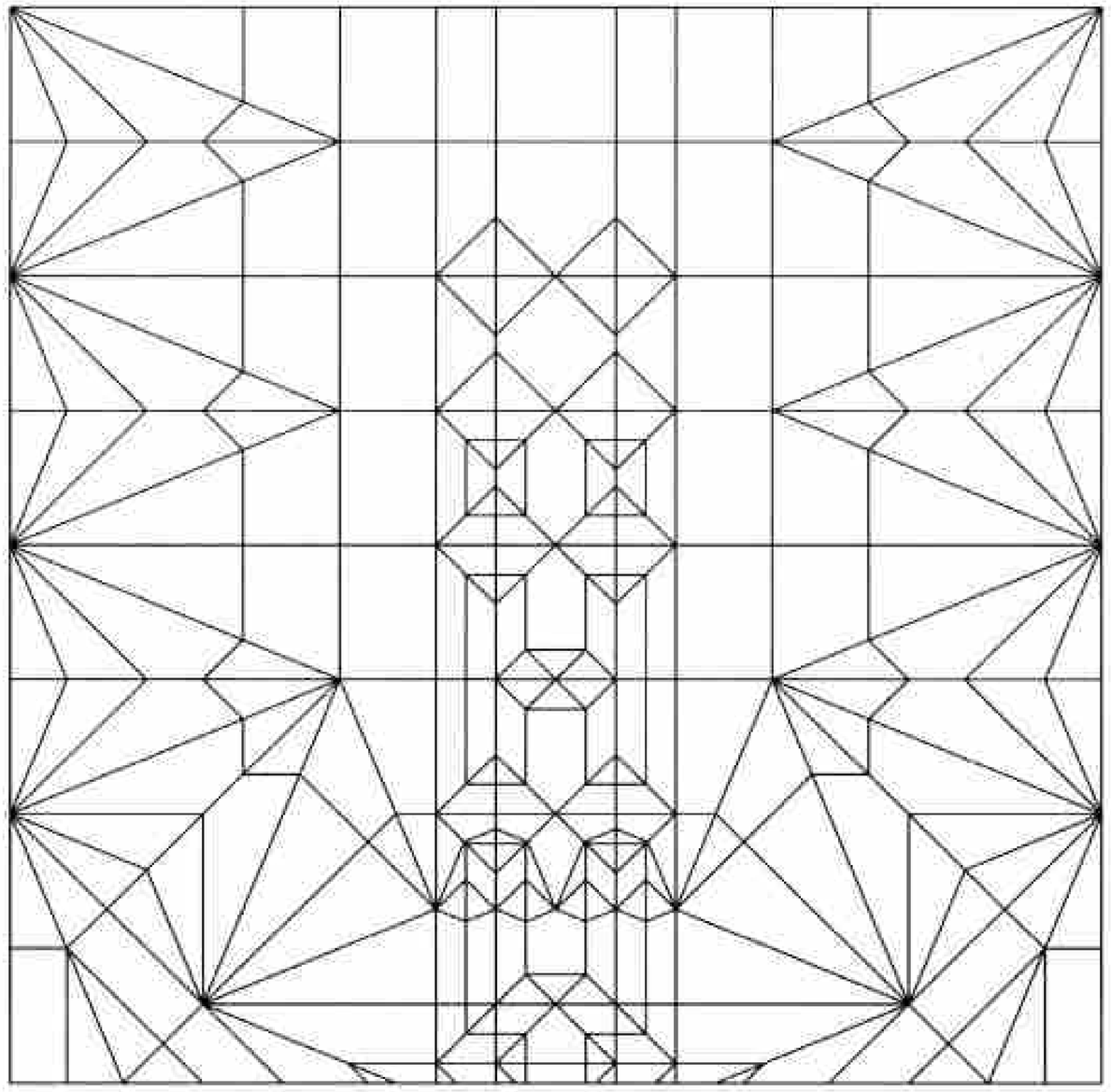


Crustaceans

Dungeness Crab

Dungeness Crab

The crab has been one of my favorite subjects to fold and design. One of the most important goals for this model was to make the anatomy realistic by making sure the legs came from underneath the carapace instead of the sides. This also achieved the second goal of propping up the body from the ground. An interesting thing to note is that searching up photos of crabs online turns up crabs outside of water, which have less lively poses than crabs underwater. Therefore, to be as realistic as possible, one must search up photos of crabs underwater.

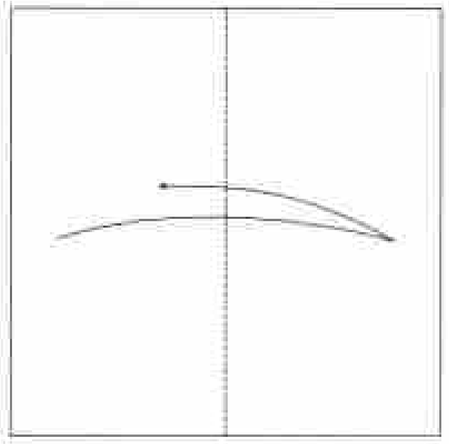




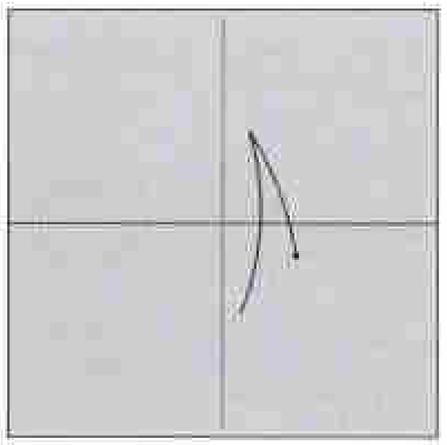
9

Repeat two more times on each flap. Then, repeat on the left side.

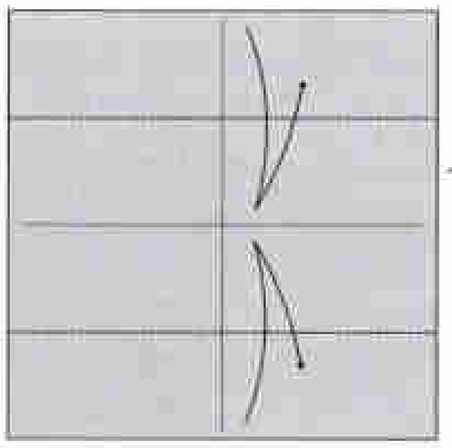
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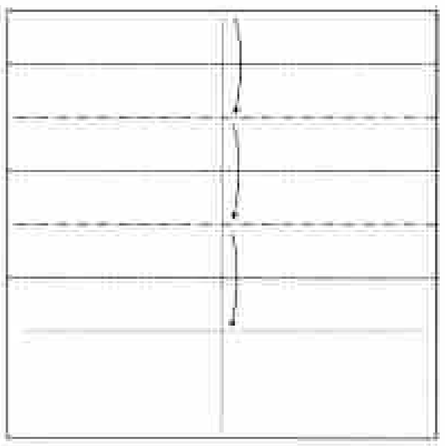
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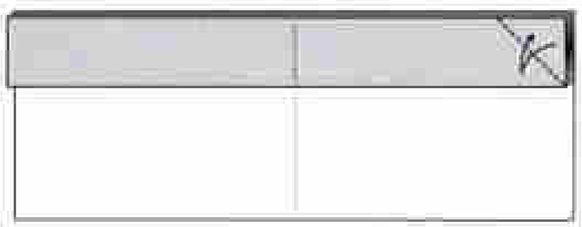
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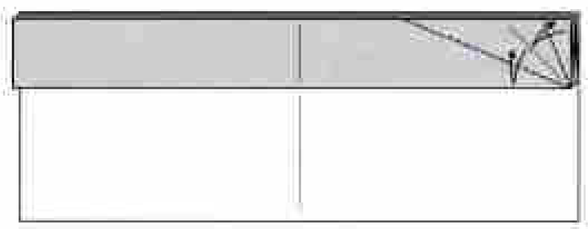
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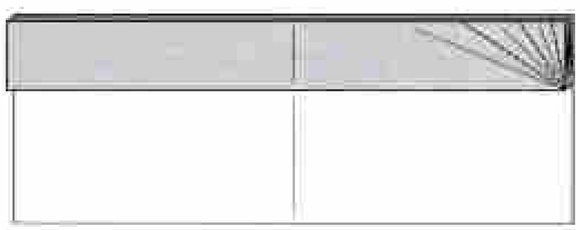
5



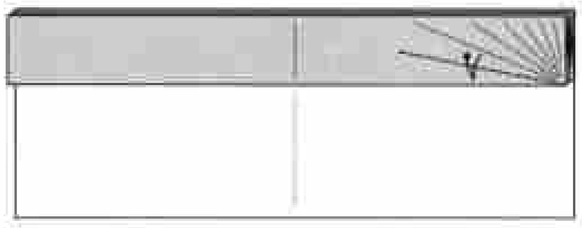
6



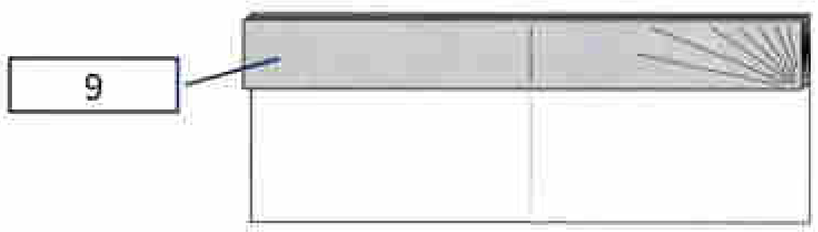
7



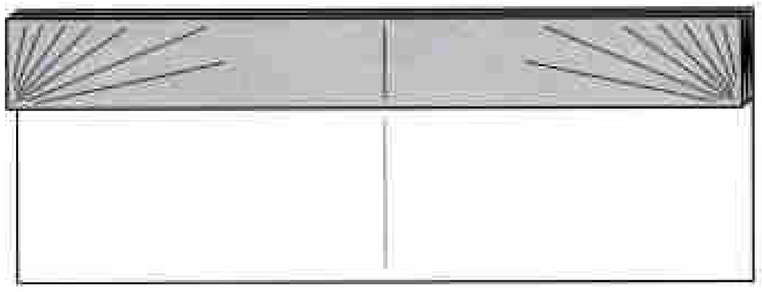
8



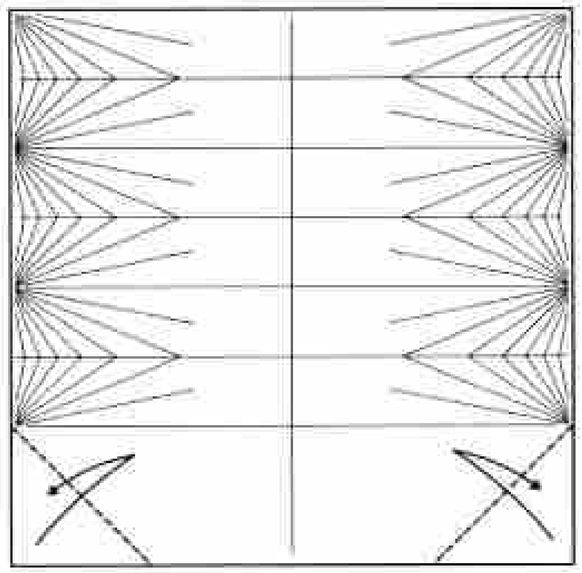
9



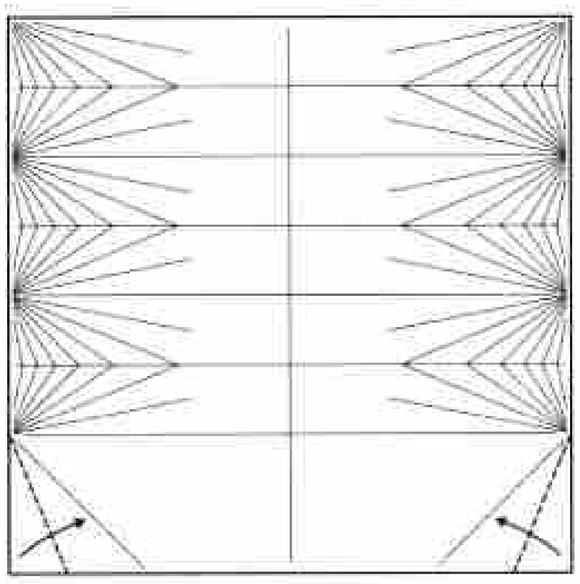
10



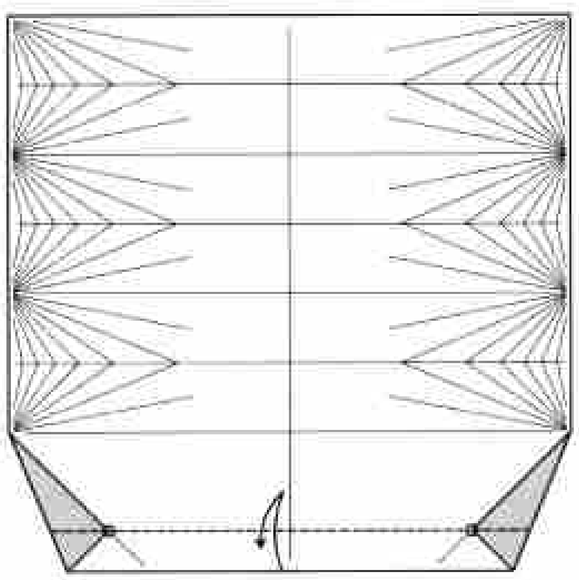
11



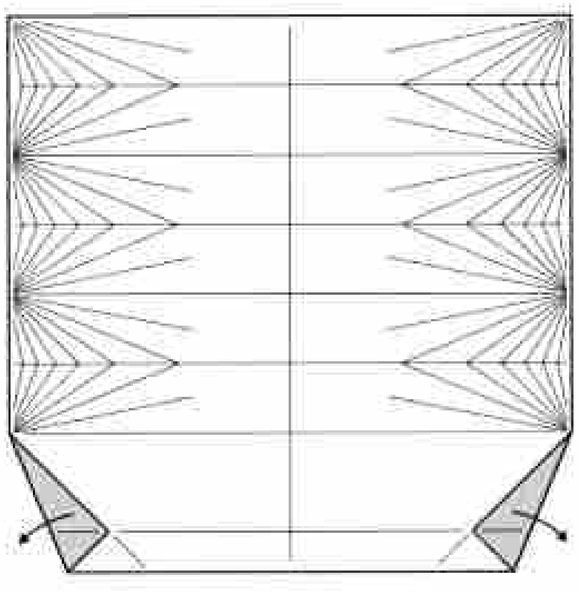
12



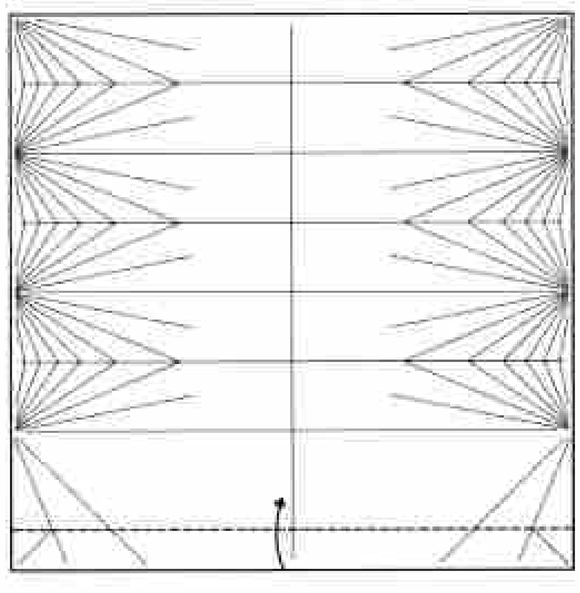
13



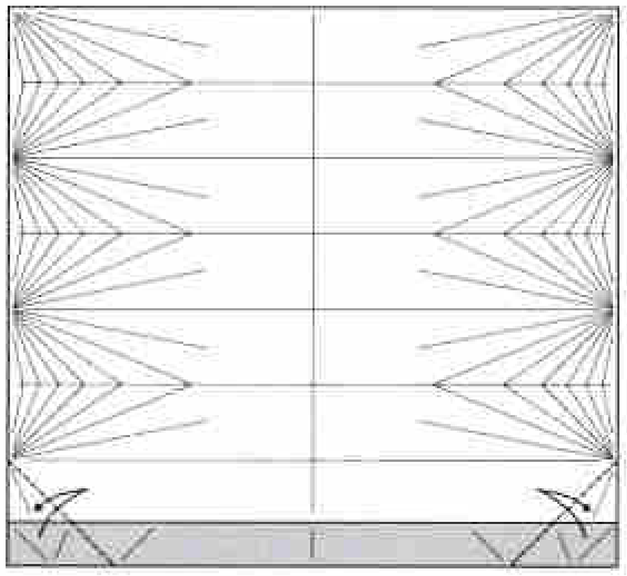
14



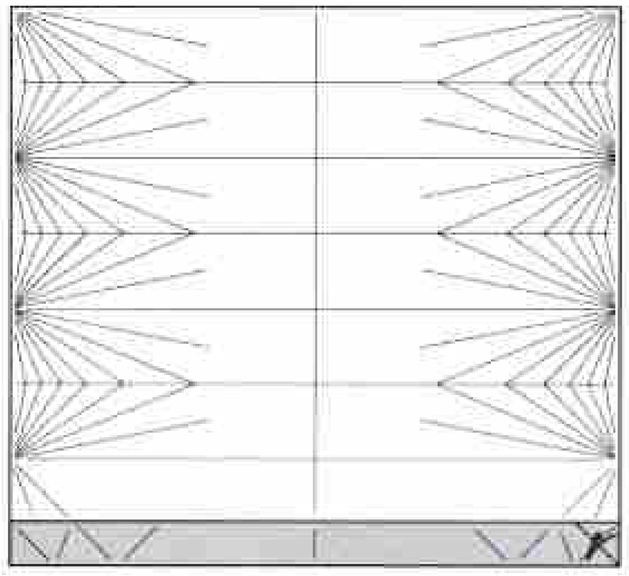
15



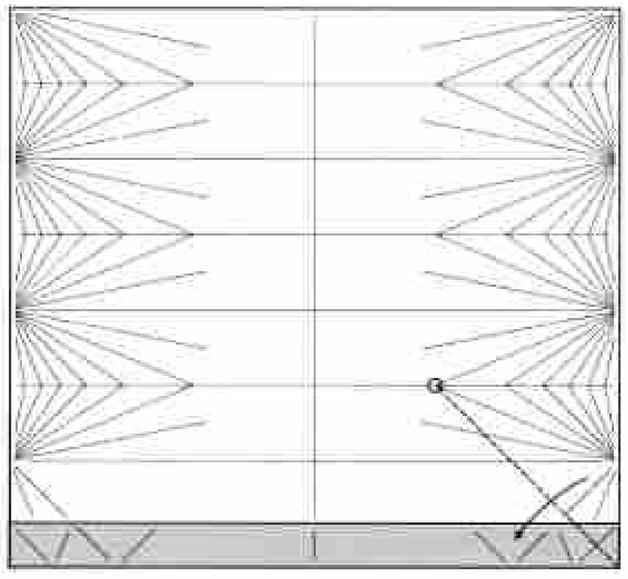
16



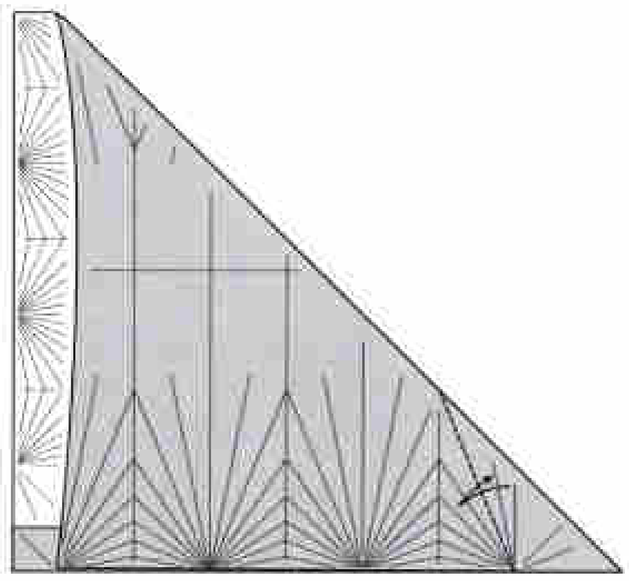
17



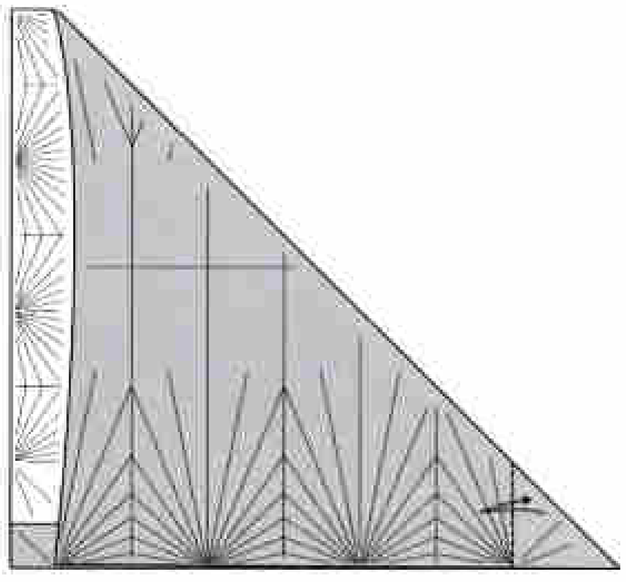
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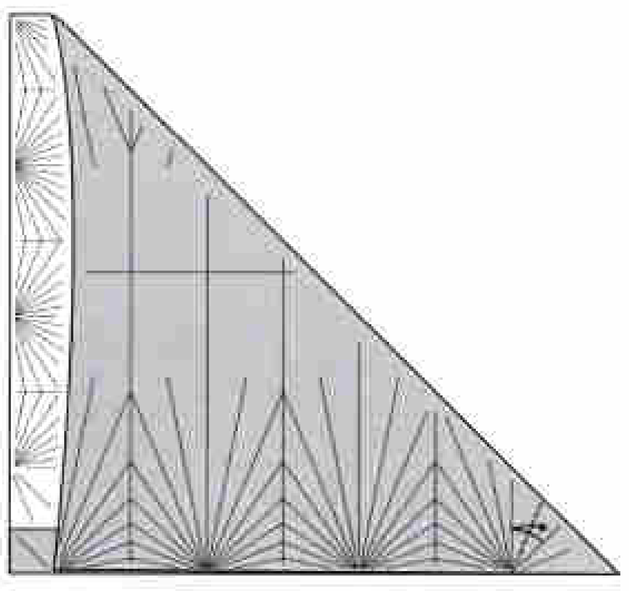
19



20



21



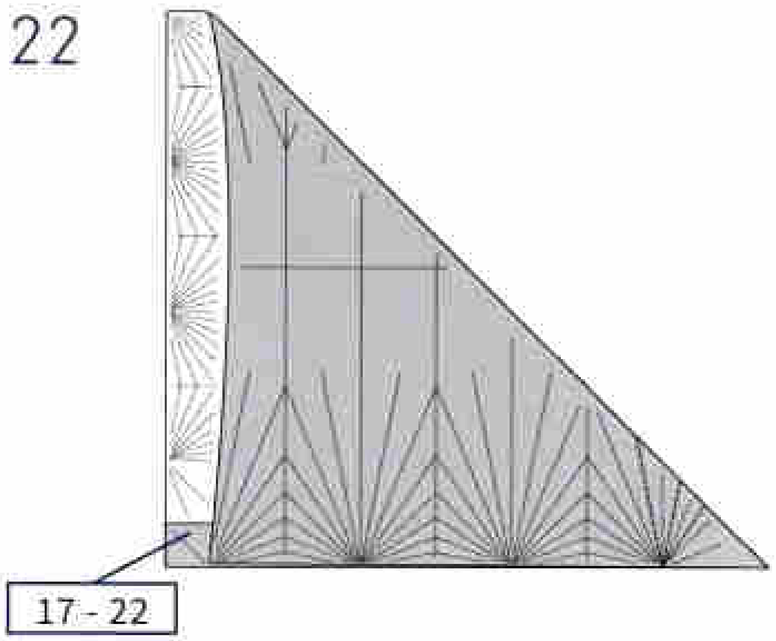
22

Three angle bisectors and unfold. Repeat steps 17 to 22 on the left side.

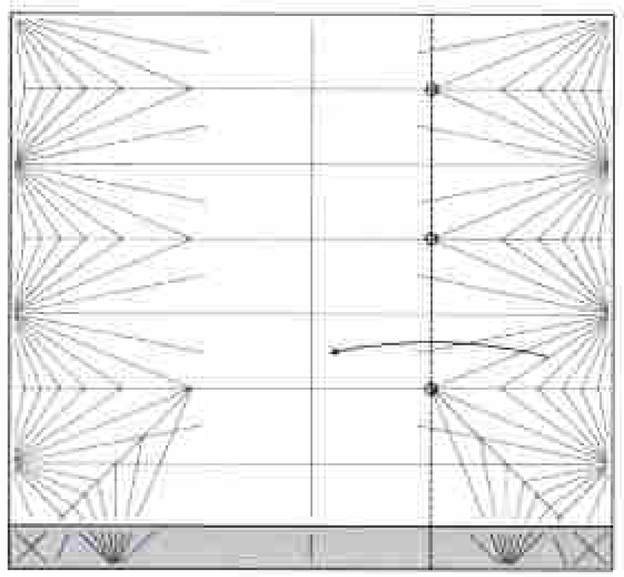
27

Repeat steps 23 to 26 on the left side.

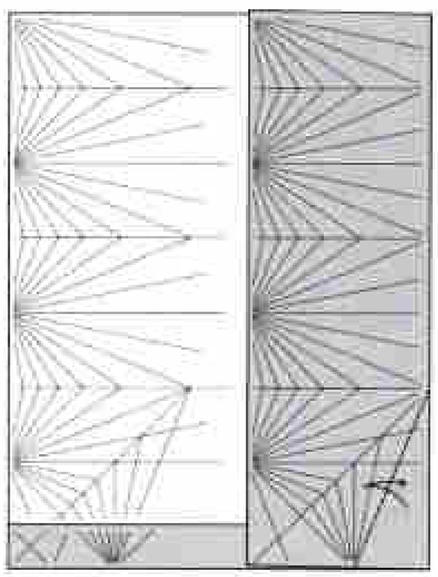
22



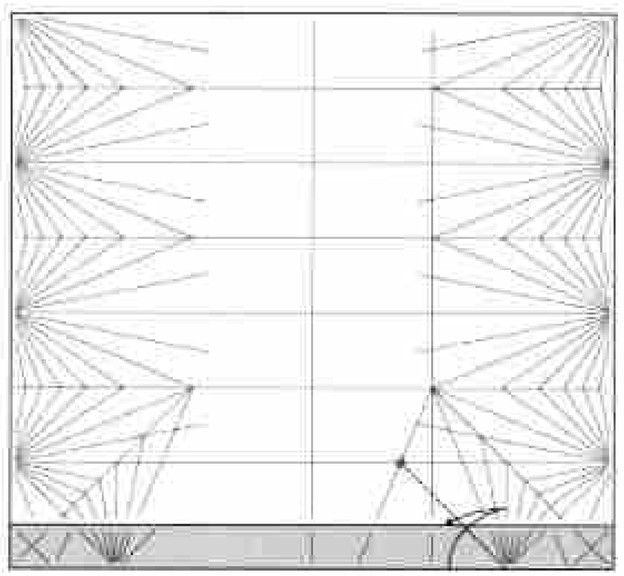
23



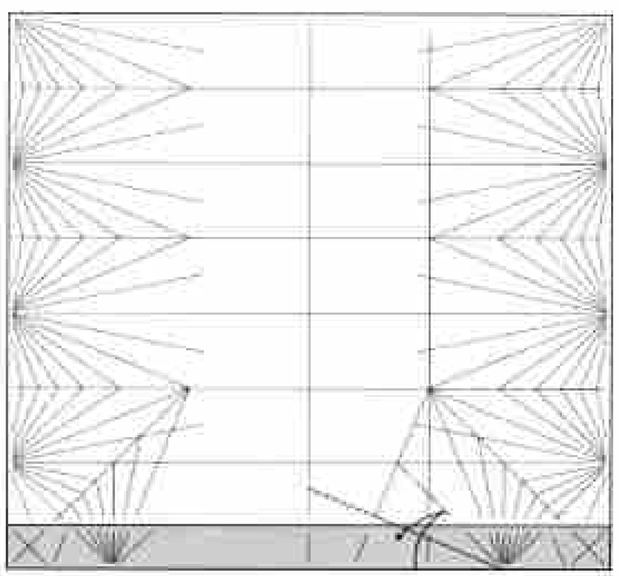
24



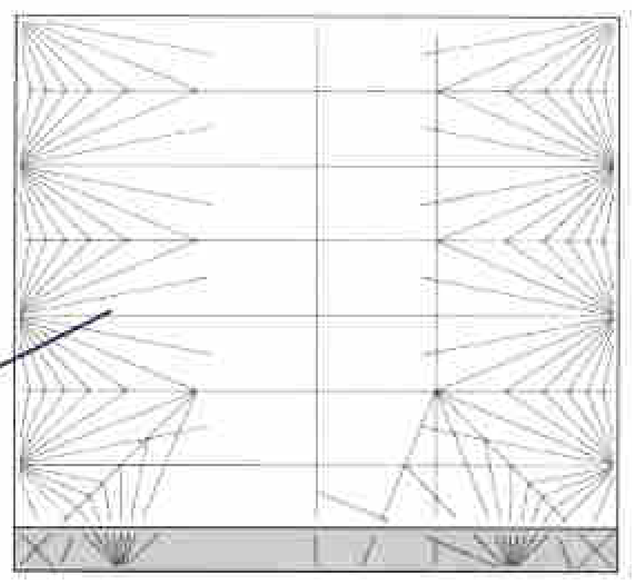
25



26

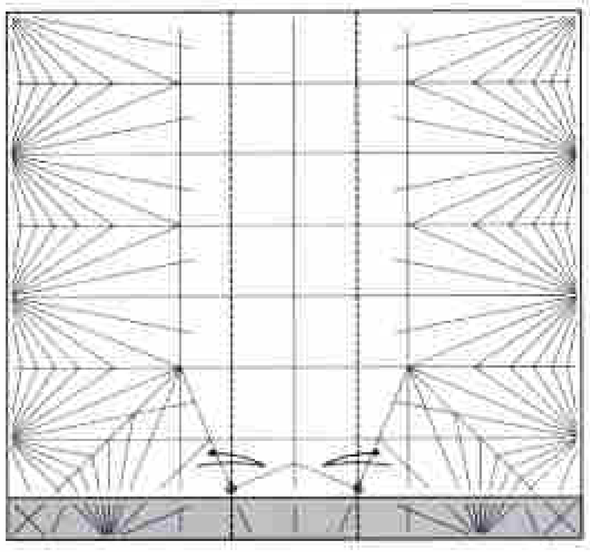


27

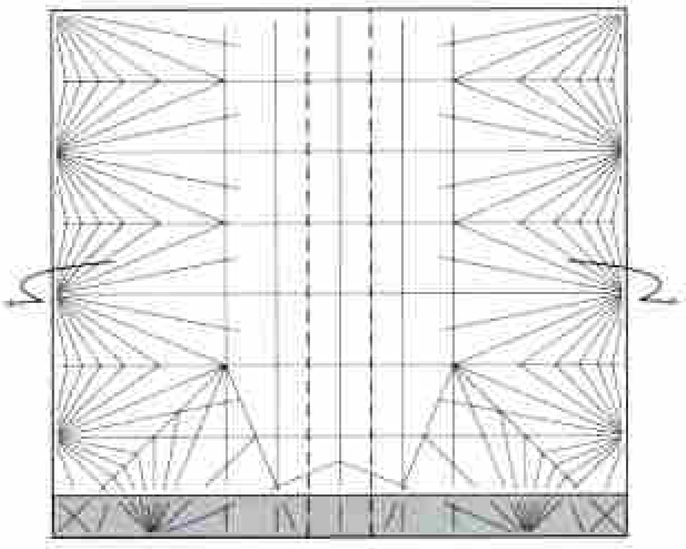


30
Unfold.

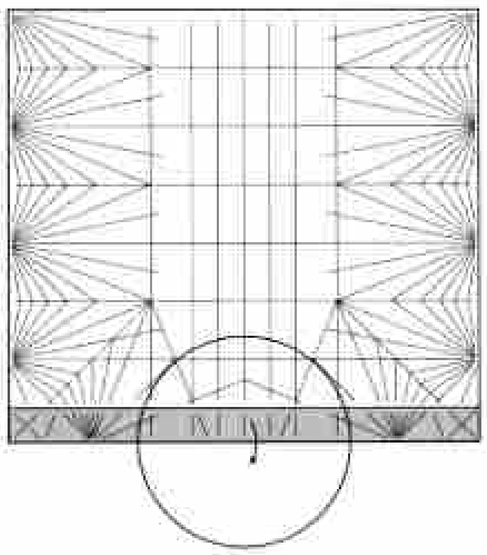
28



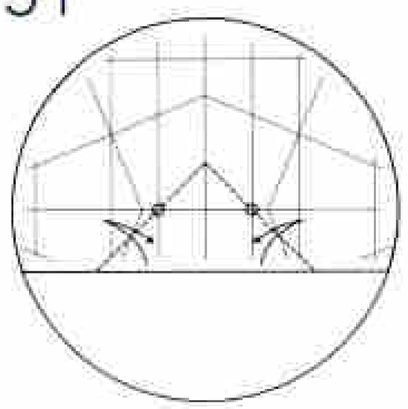
29



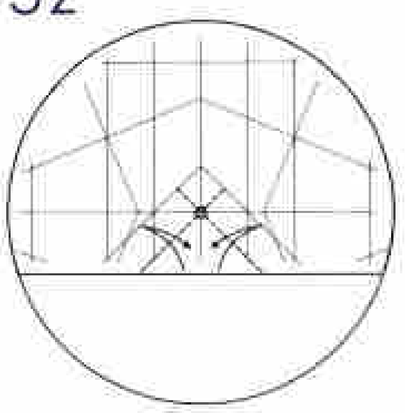
30



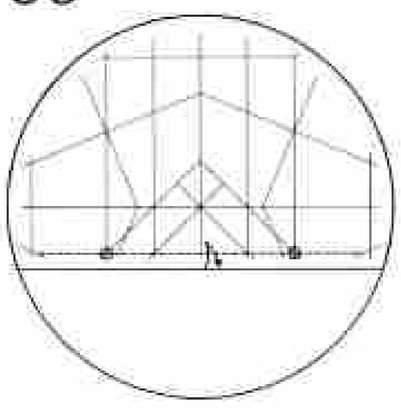
31



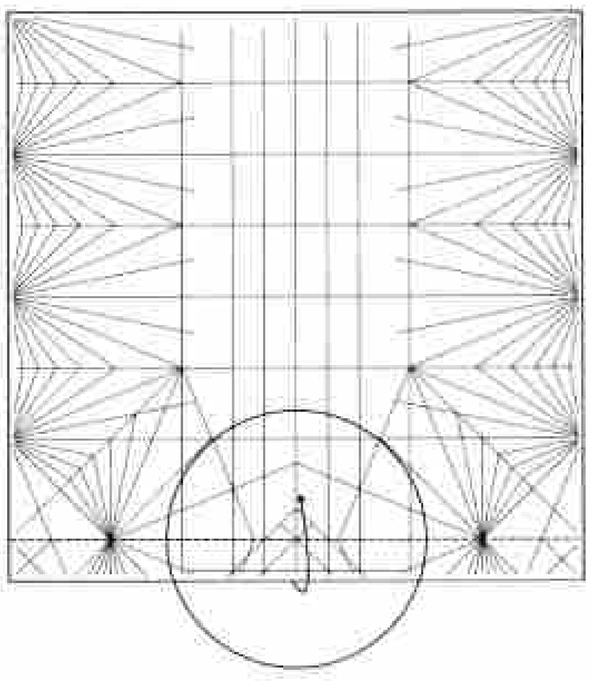
32



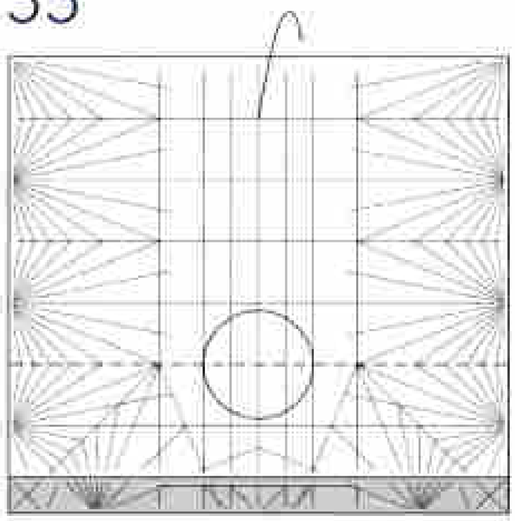
33



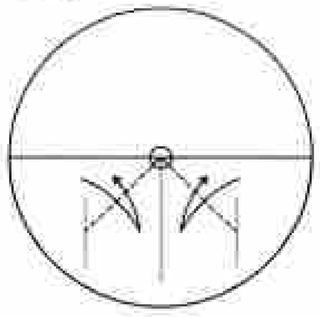
34



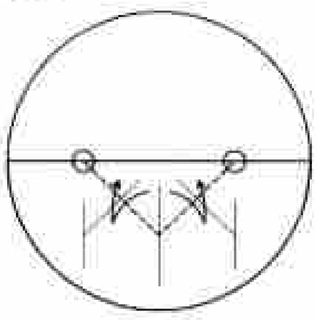
35



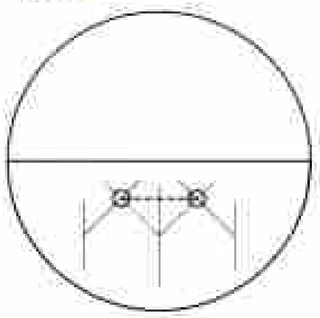
36



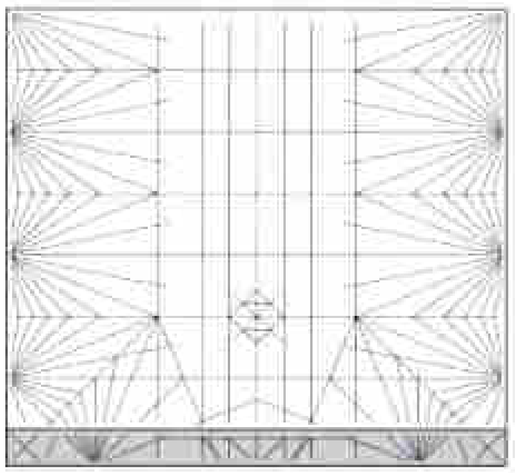
37



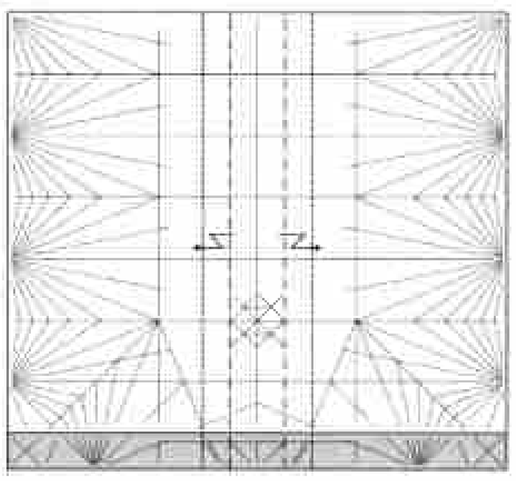
38



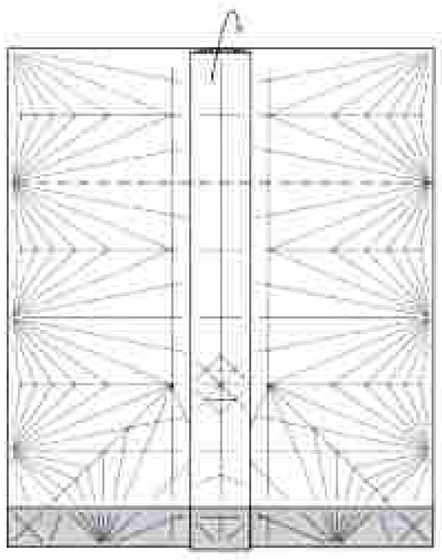
39



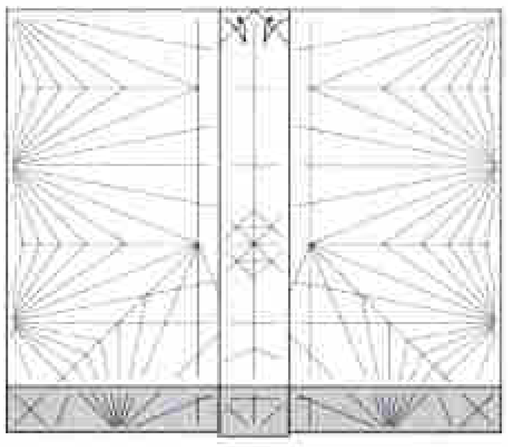
40



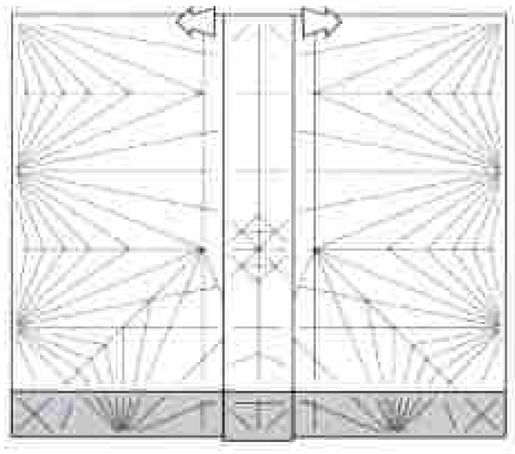
41



42



43



44

Squash the tops and fold the flaps away from the center.

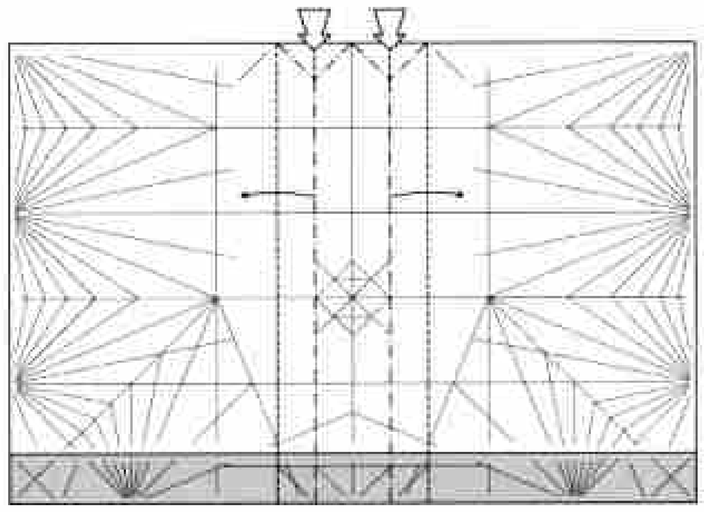
46

Closed sink.

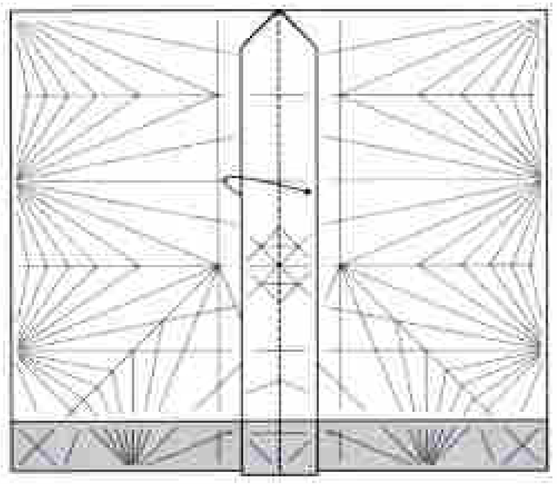
47

Repeat steps 45 and 46 on the right side.

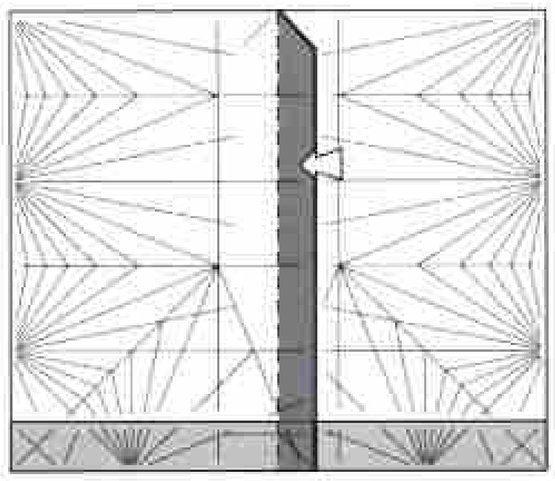
44



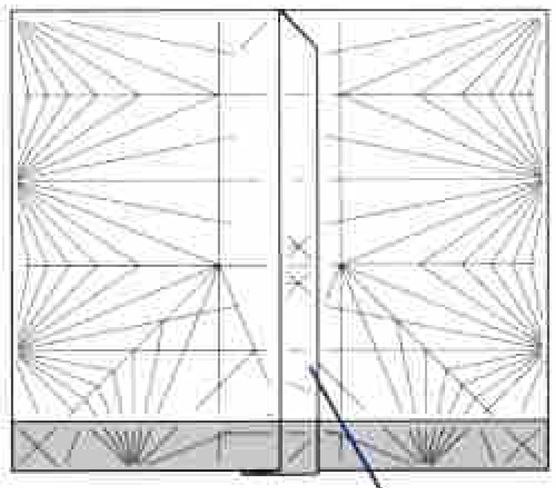
45



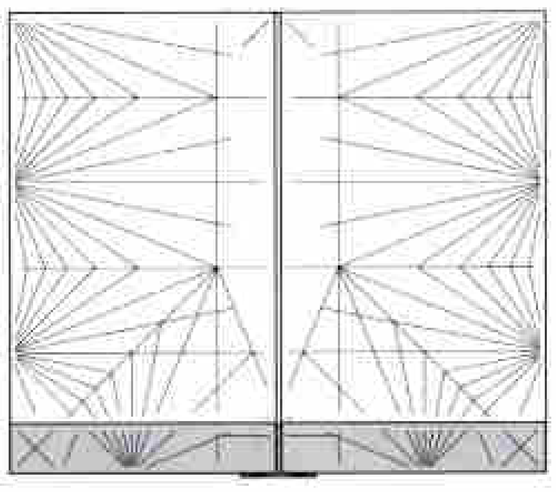
46



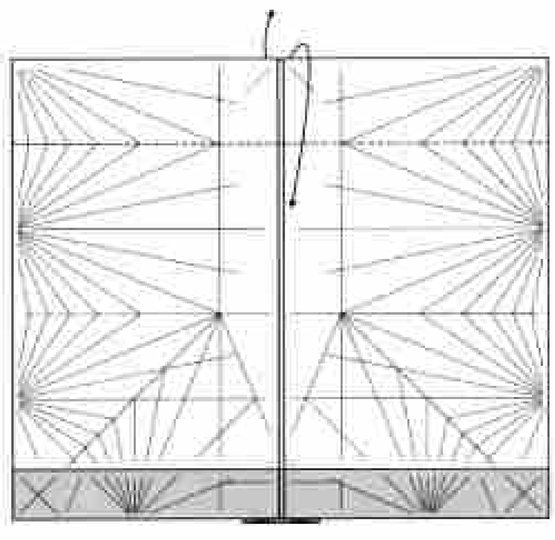
47



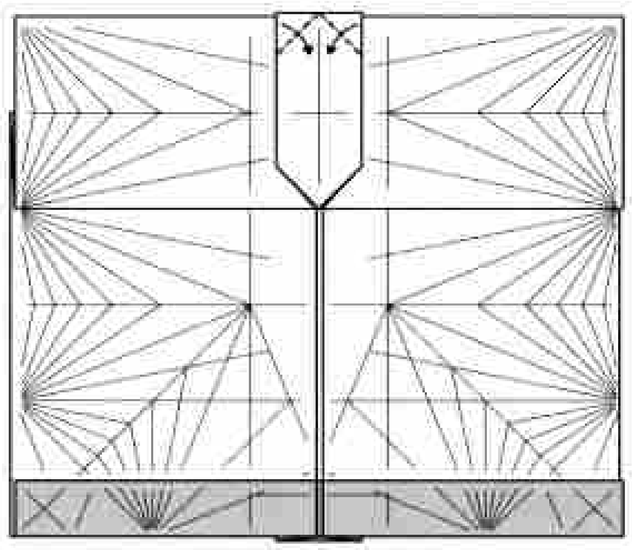
48



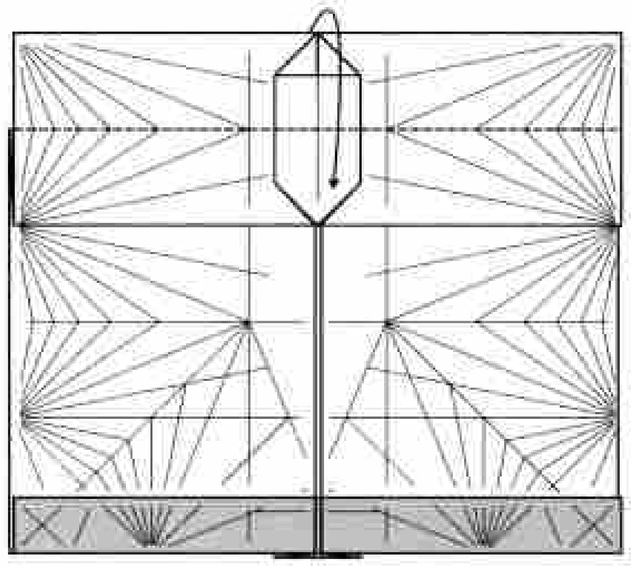
49



50



51



52

Repeat steps 42 to 44.

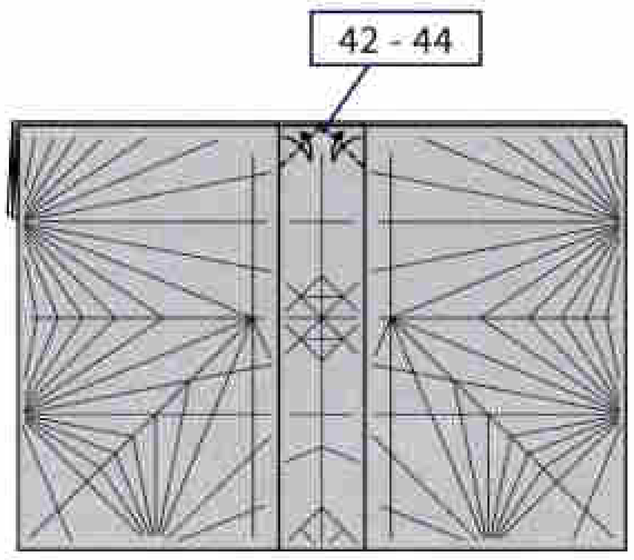
54

Open the flaps and pleat.

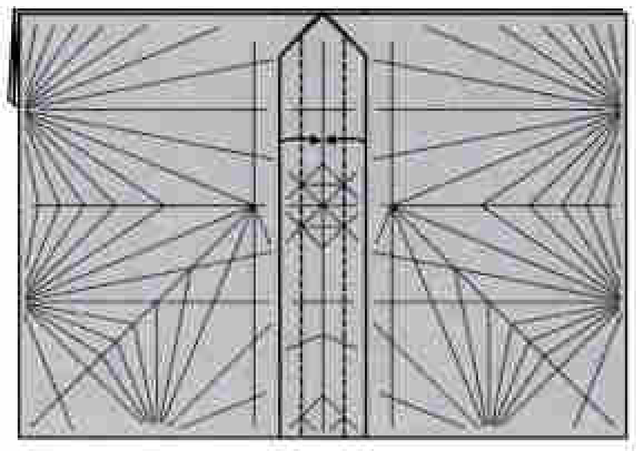
55

Open the flaps and fold up. Flip over.

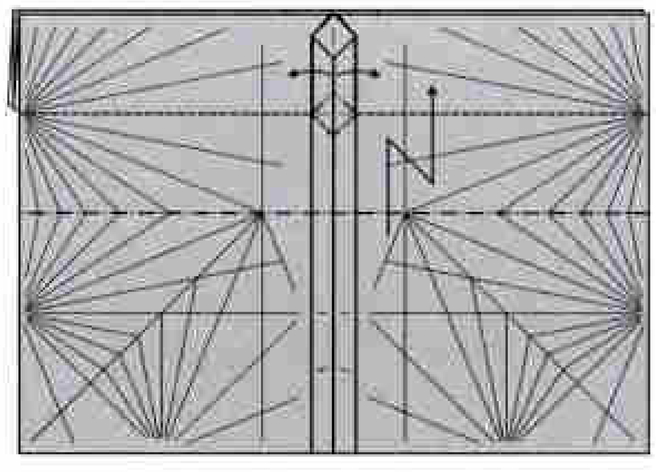
52



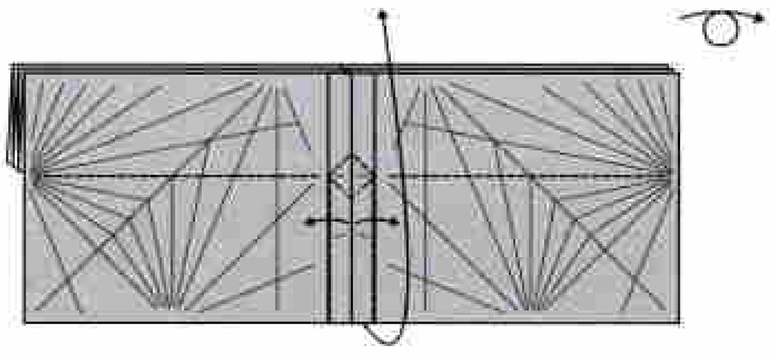
53



54



55



56
Inside view of the bottom flap. Closed sink.

57
Closed sink completed. Flip over.

59
Lift up two layers.

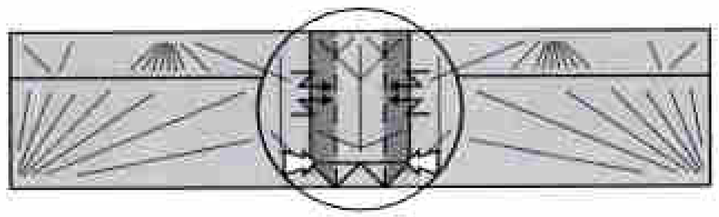
60
Open, but do not crease.

61
Collapse as shown.

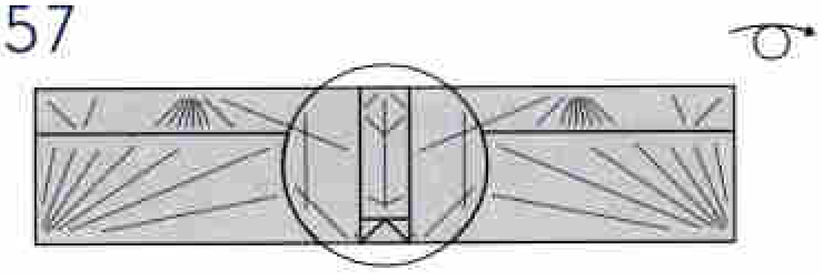
62
Tuck the side flaps inside and close the model. If steps 60 to 61 are too difficult, skip these steps.

63
Inside reverse fold.

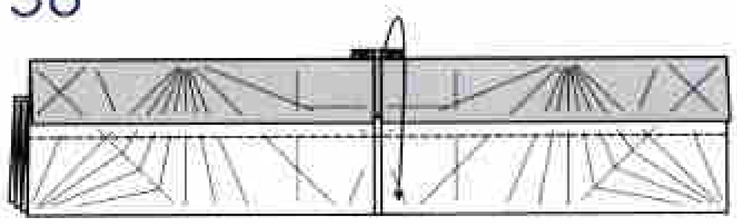
56



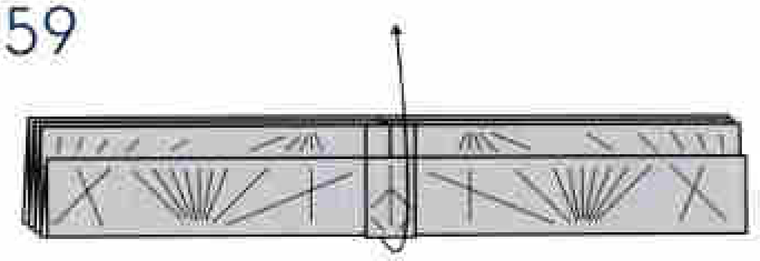
57



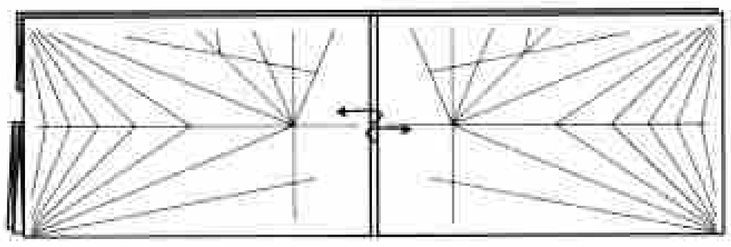
58



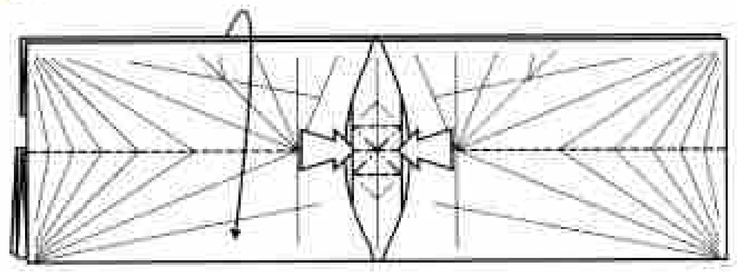
59



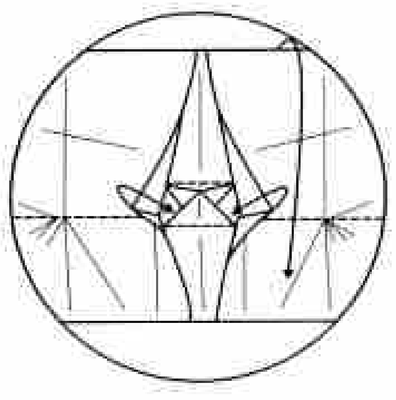
60



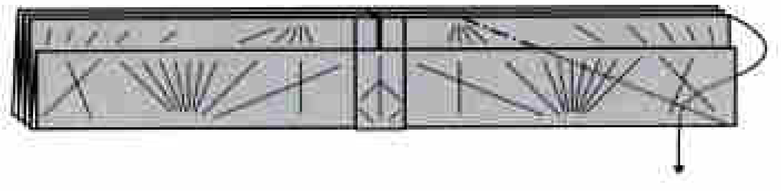
61



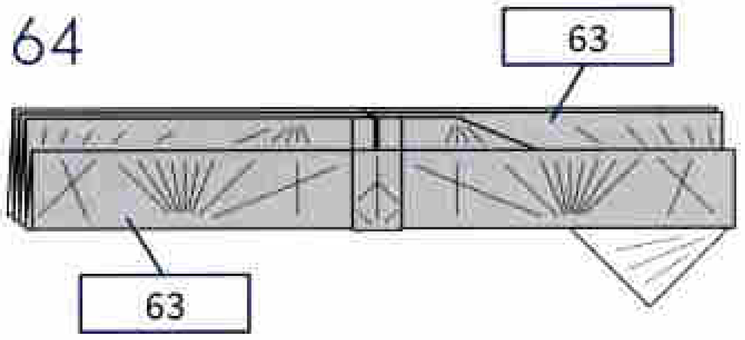
62



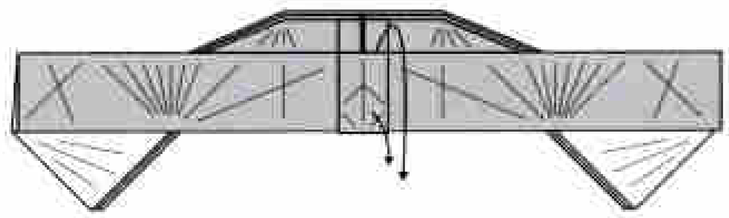
63



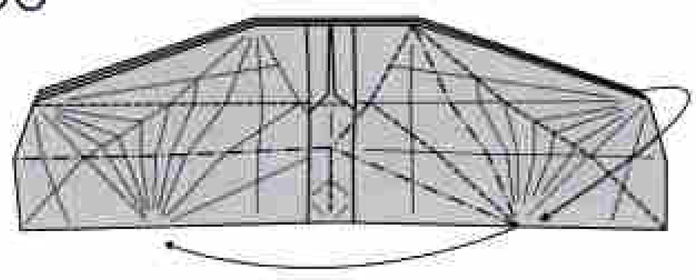
64



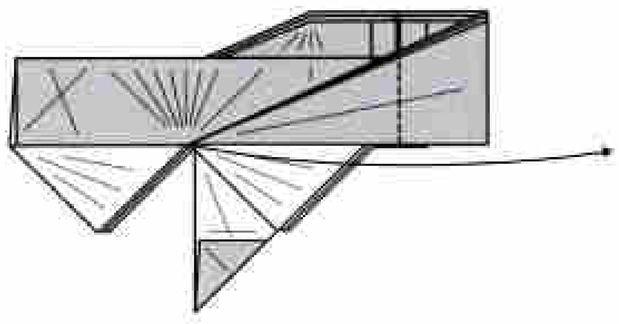
65



66



67



64
Repeat on all flaps.

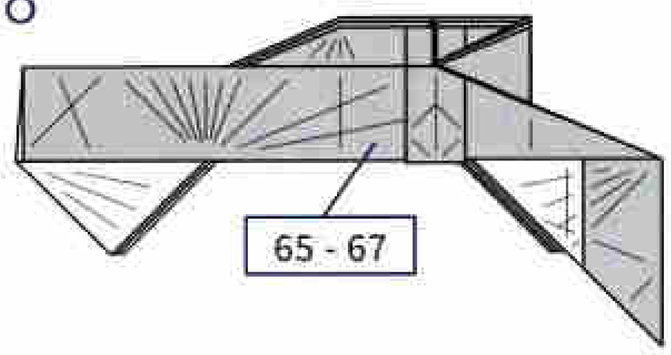
65
Pull out the layers.

66
Collapse as shown.

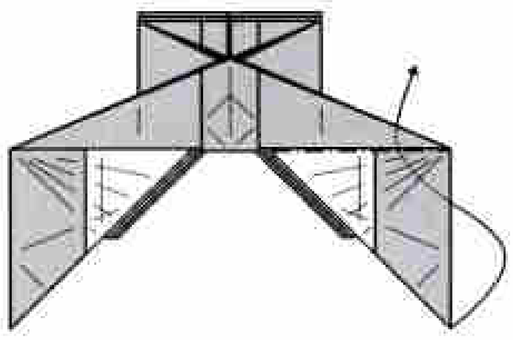
68
Repeat steps 65 to 67 on the left side.

69
Inside reverse fold.

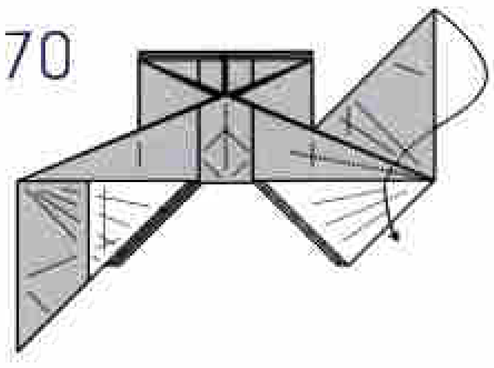
68



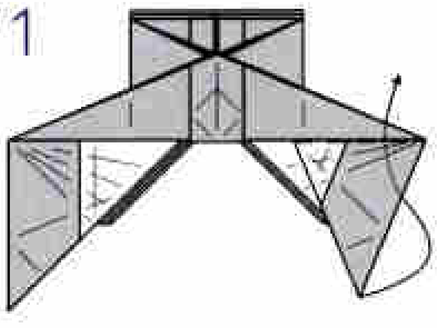
69



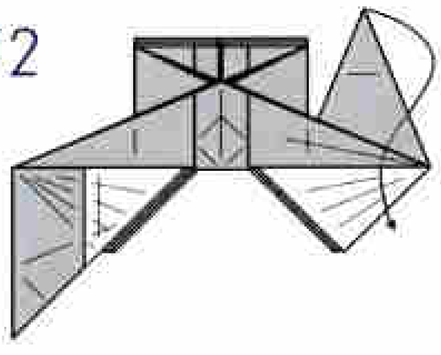
70



71



72



73
Pull out paper.

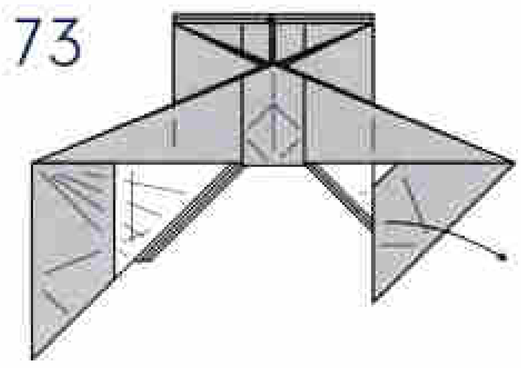
79
Thin the leg and valley fold.

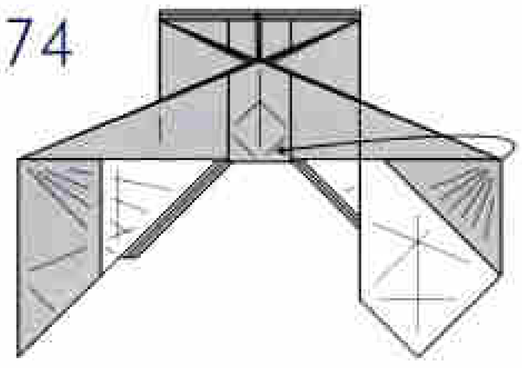
80
Repeat steps 69 to 79 on the left side.

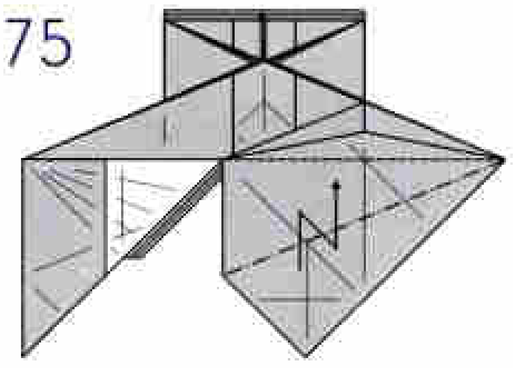
81
Pull out paper.

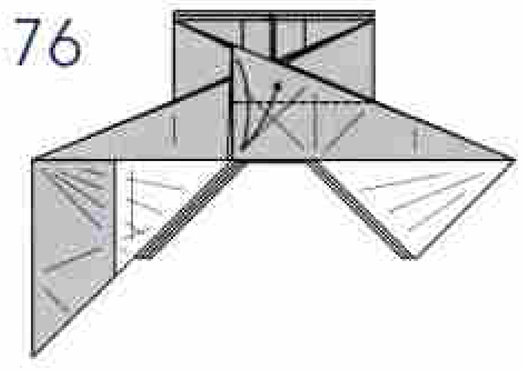
82
Mountain fold along the edge of the paper.

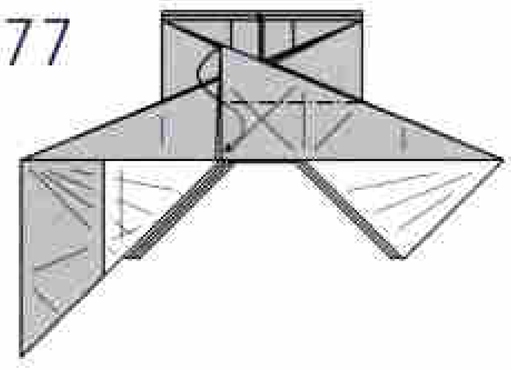
83
Fold up and squash the sides.

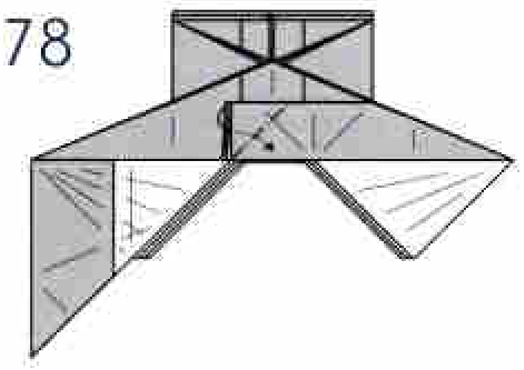


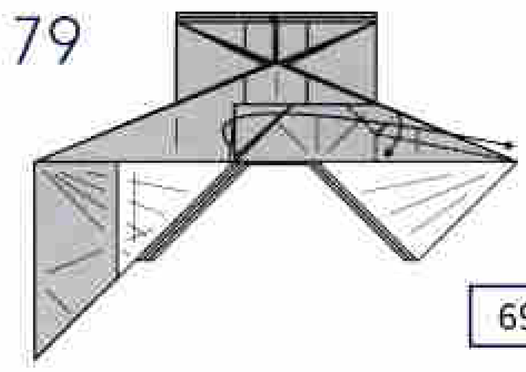


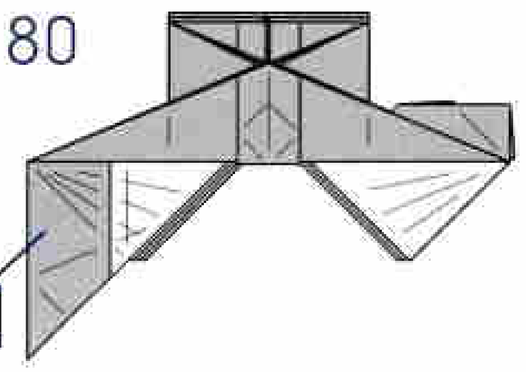


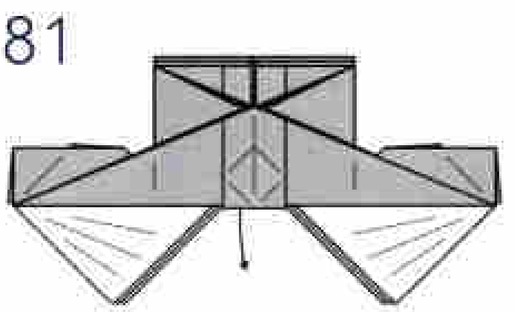


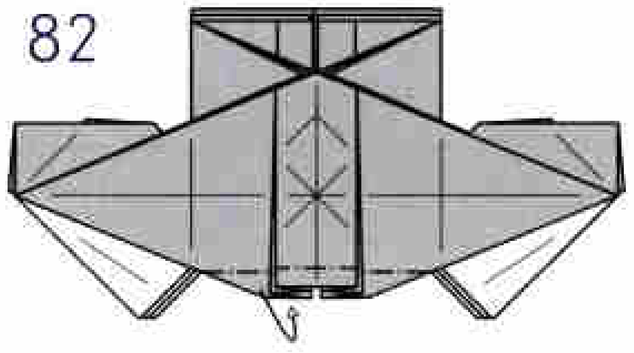


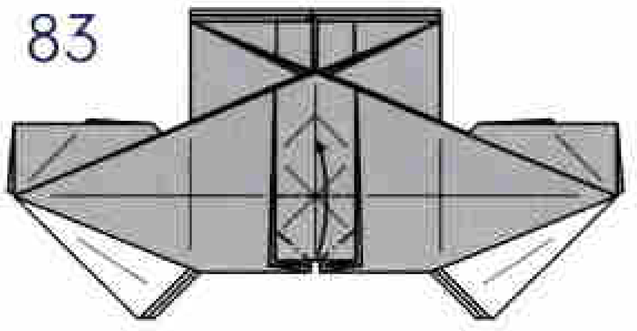




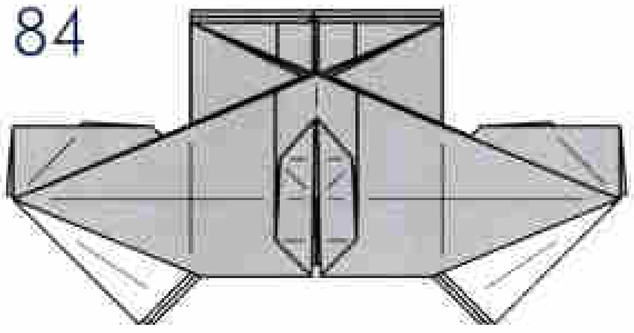




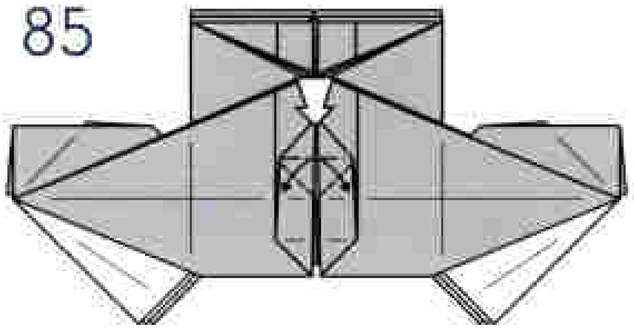




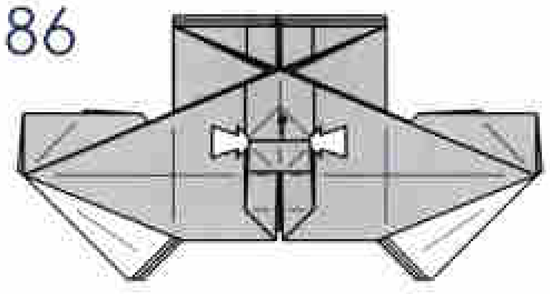
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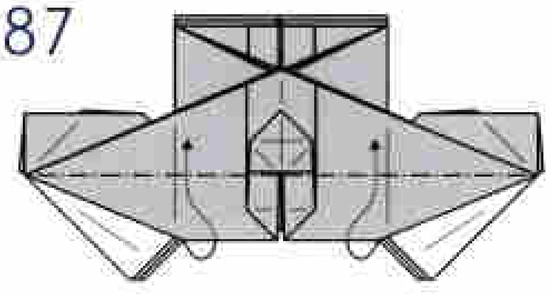
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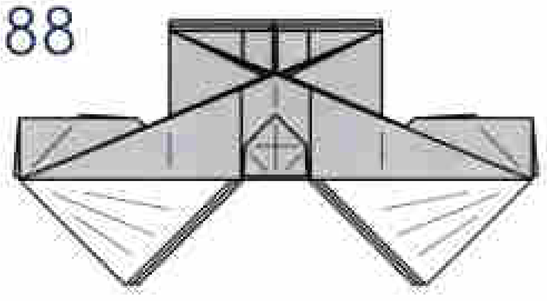
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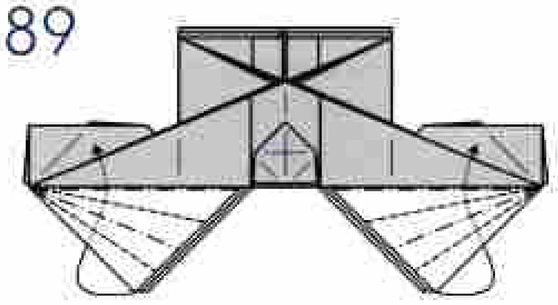
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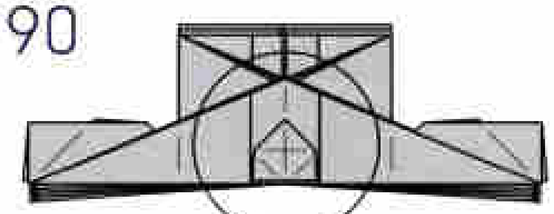
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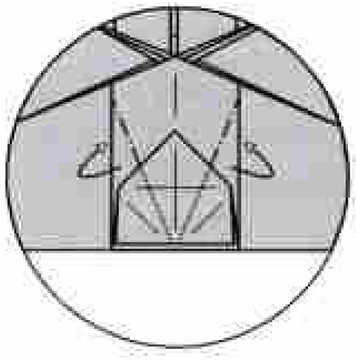
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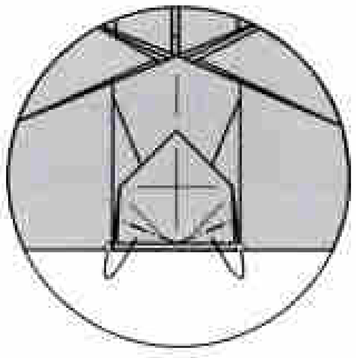
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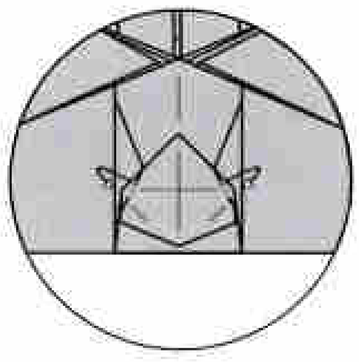
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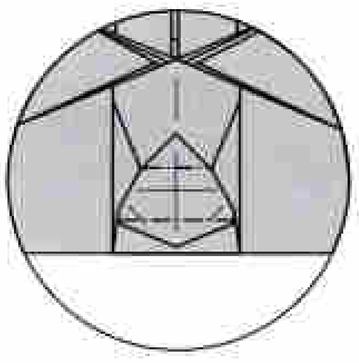
92



93



94



85
Squash.

86
Collapse the sides in and lift up the point.

87
Inside reverse folds.

89
Reverse folds on all flaps.

94
Form creases.

96
Valley fold and angle bisector.

97
Notice the edge of the flap in step 96 is parallel to the edge of the model. Unfold.

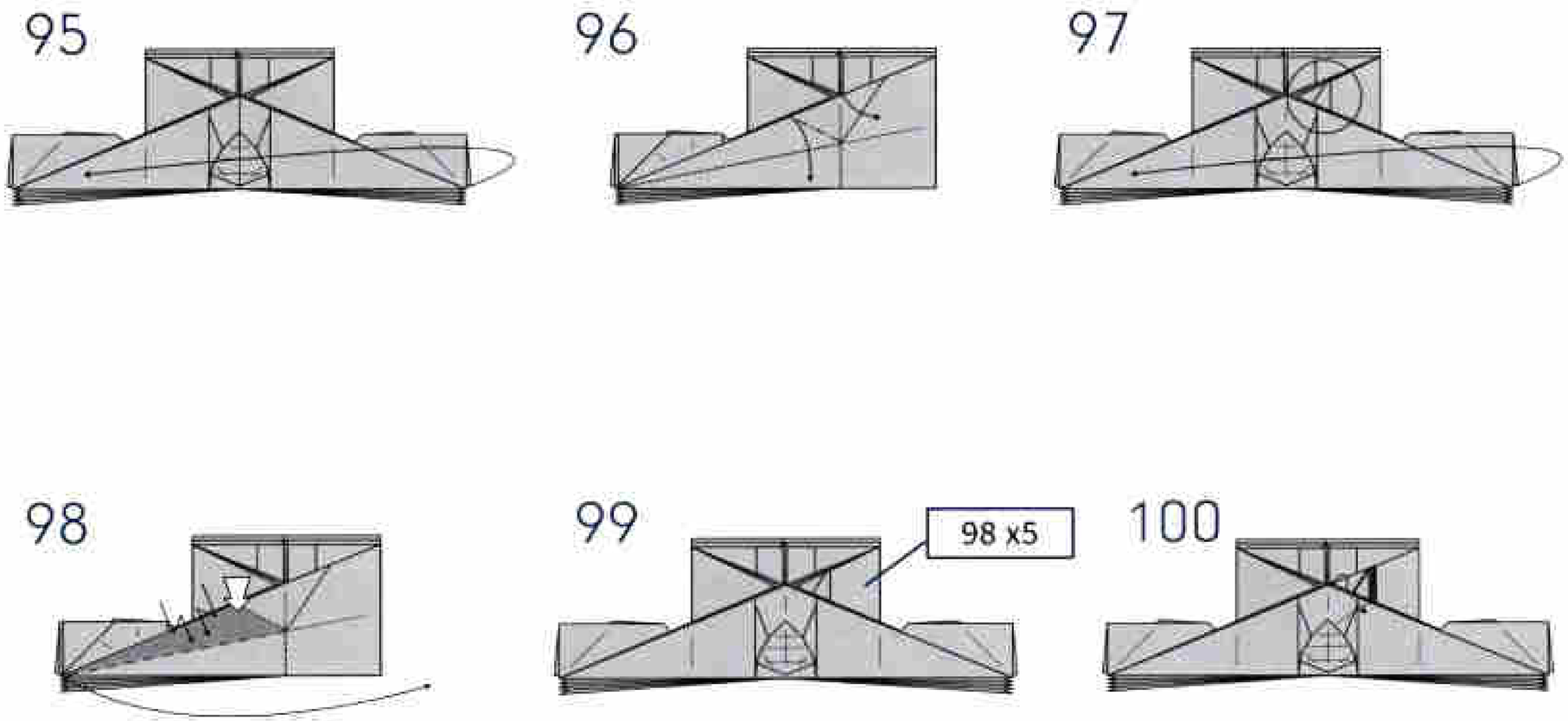
98
Valley fold and sink.

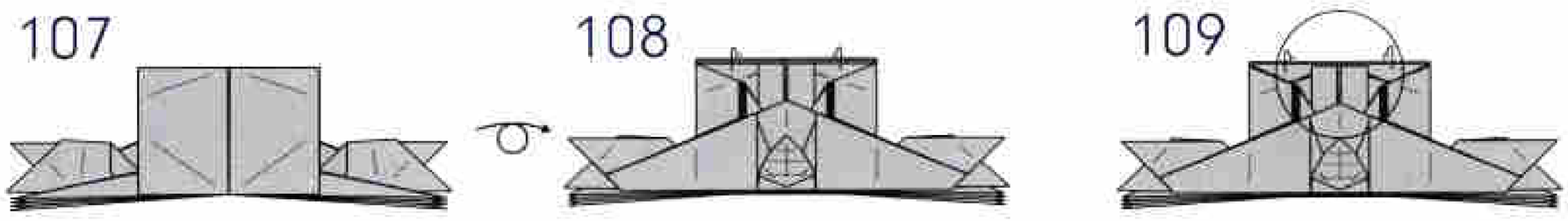
99
Repeat 5 more times on the right side.

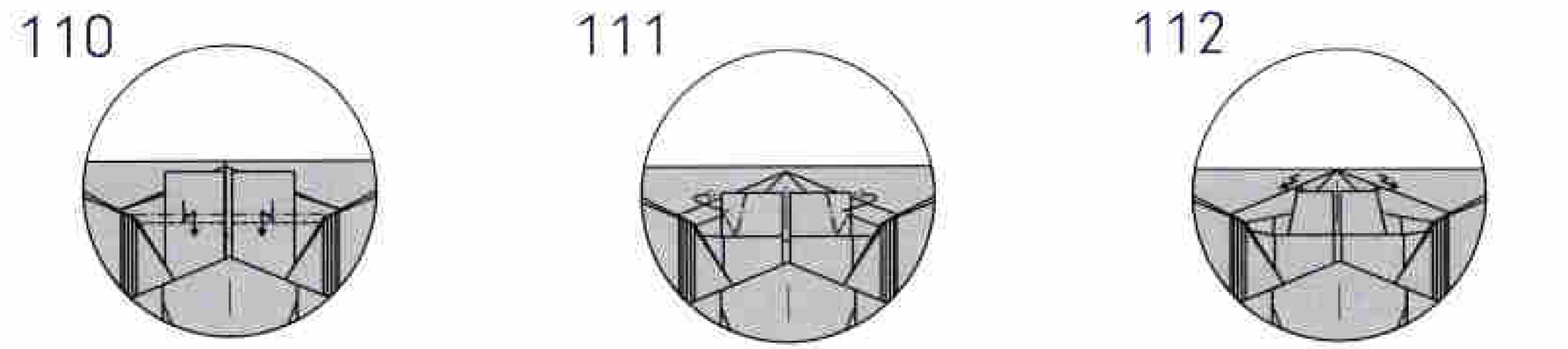
100
Inside reverse fold the last flap.

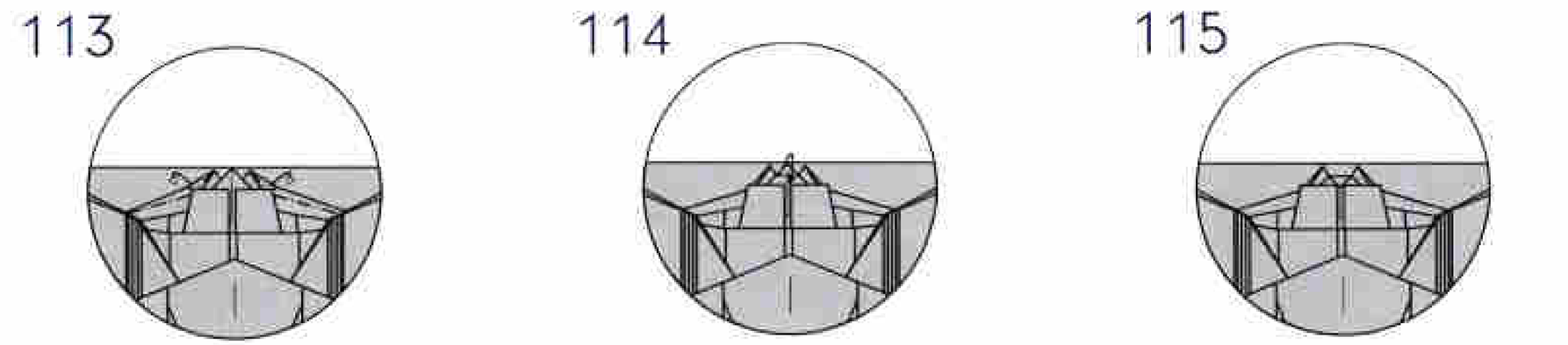
101
Repeat steps 95 to 100 on the left side.

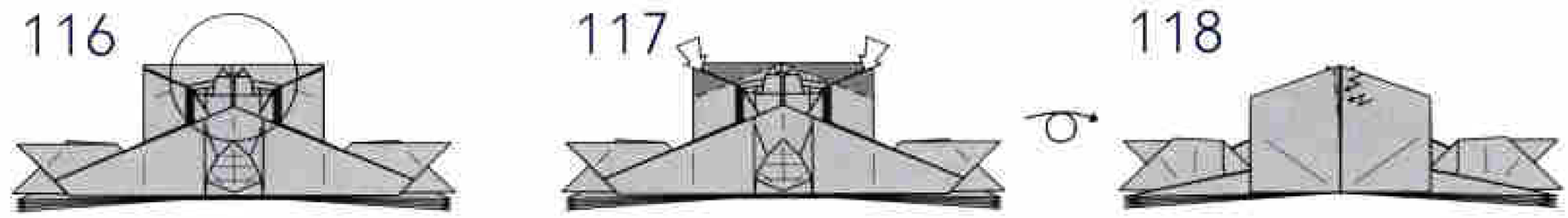
106
Inside view. Mountain fold the indicated flaps to lock the back of the body.











108
Mountain folds.

109
Mountain folds.

112
Shift the eyes out.

113
Mountain fold.

114
Valley fold the corner.

117
Closed sinks.

118
Crimp inside to form 3D.

119
Inside reverse folds.

120
Outside reverse fold.

121
Inside reverse fold.

122
Repeat on all legs.

123
Valley fold the back legs.

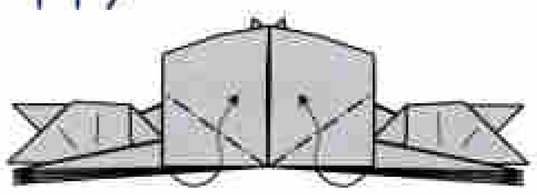
125
Bring the arms and first 2 pairs of legs to the front. Flip over.

126
Valley fold.

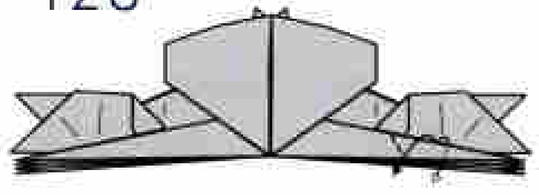
128
Shape.

129
Repeat steps 126 to 128 on the left side.

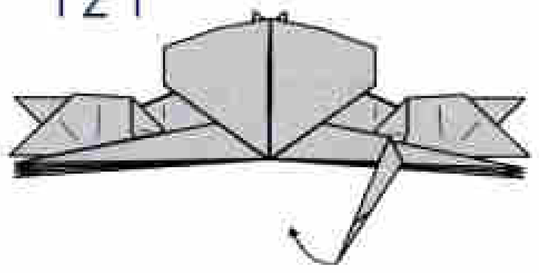
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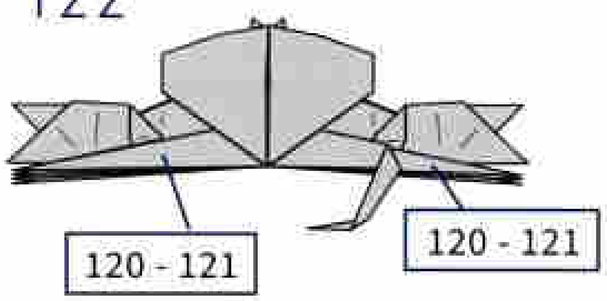
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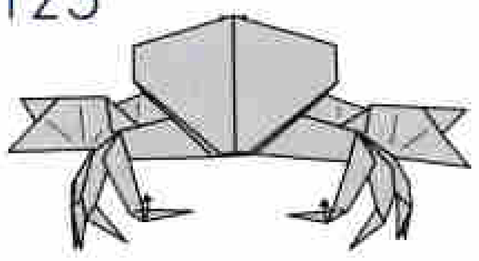
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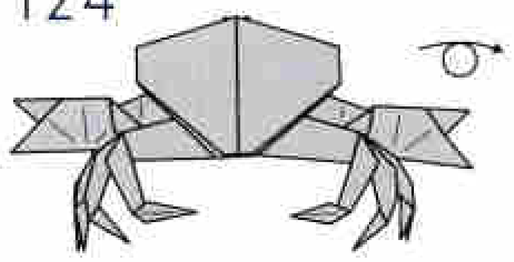
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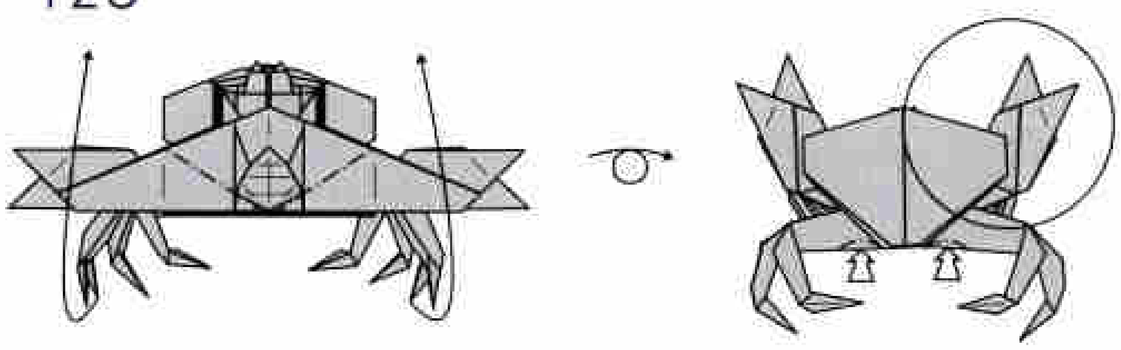
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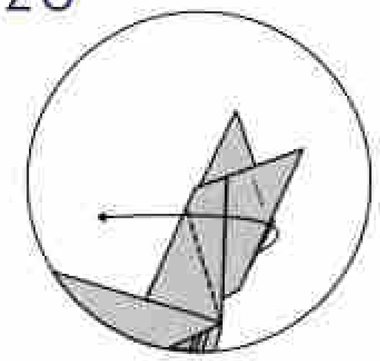
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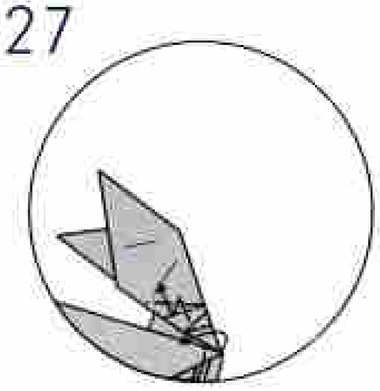
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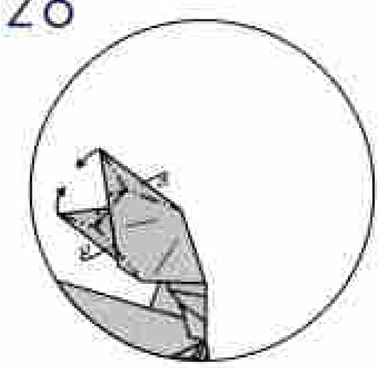
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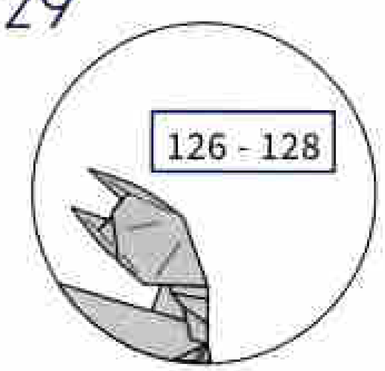
127



128



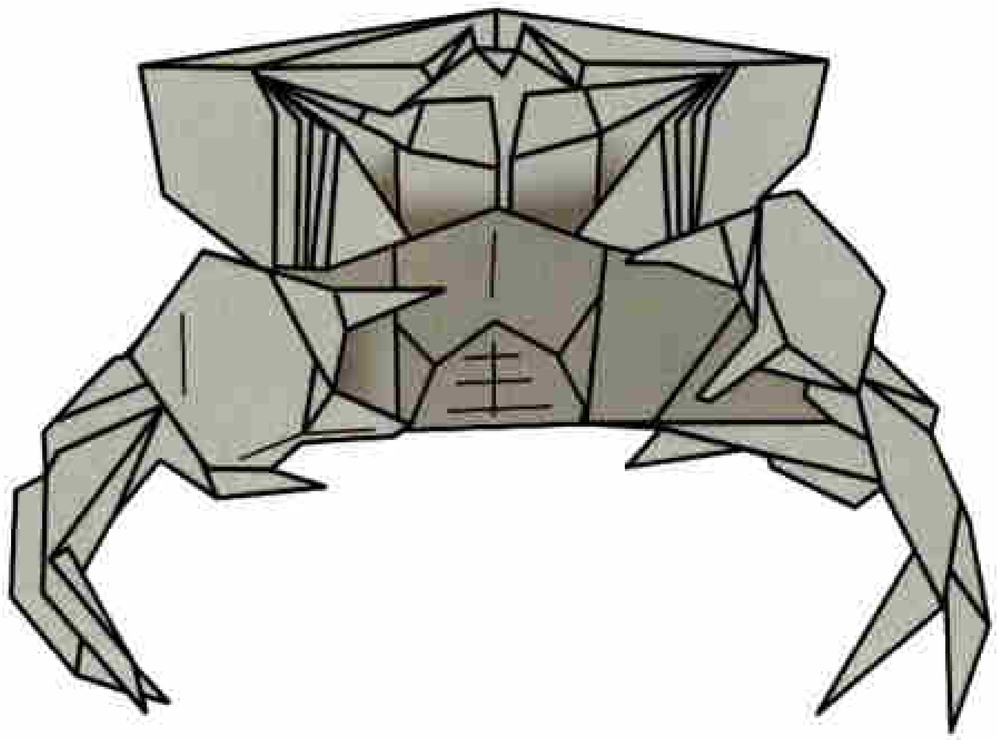
129



130

Dungeness crab
completed.

130







On Origami Design

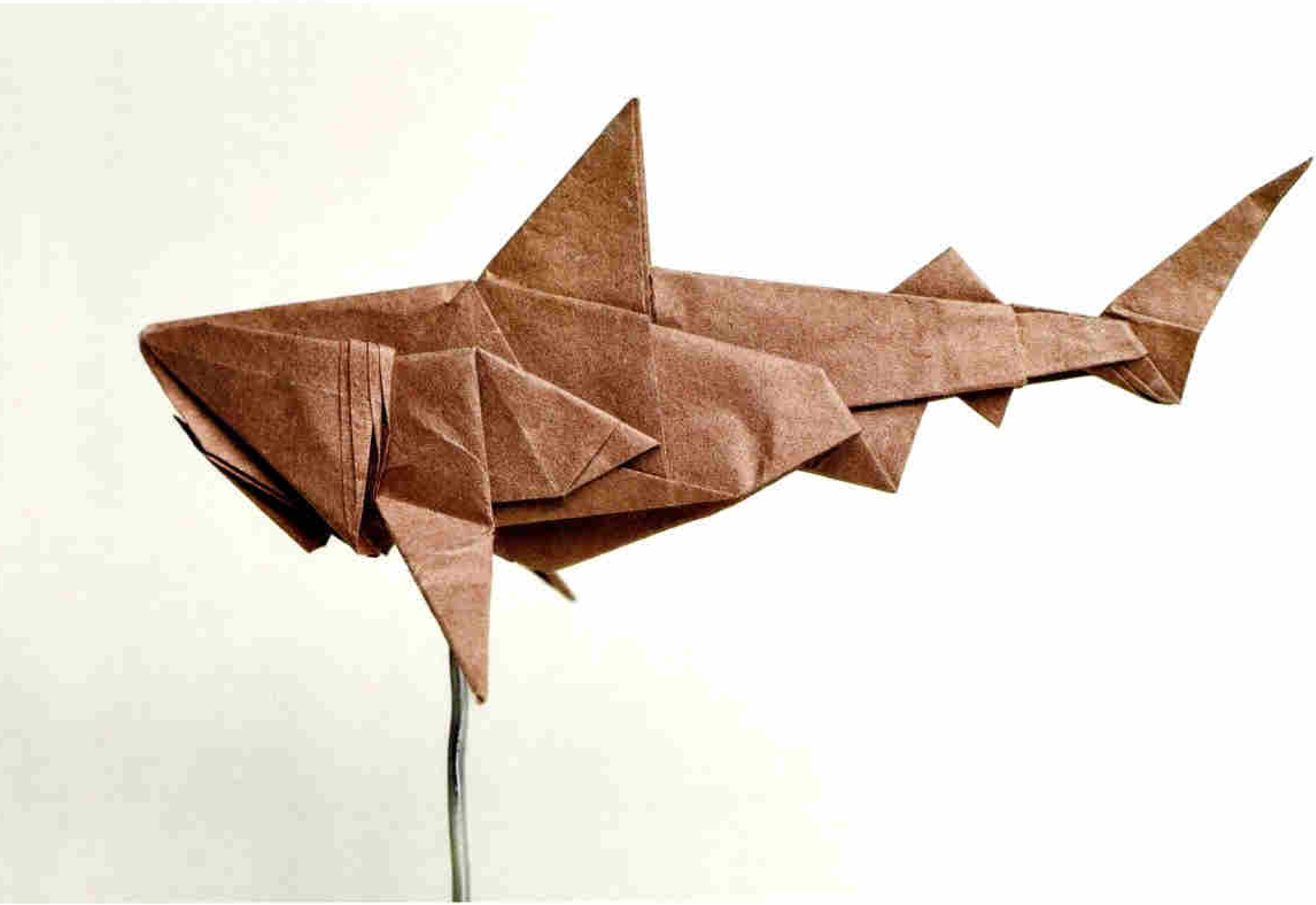
To create origami is to solve the problem: how do you distribute a square sheet of paper into a recognizable figure? This can be a challenging task that requires experience, concentration, and a lot of patience.

A great design is efficient. It has little to no wasted paper and the paper is distributed evenly throughout the structure. Correct proportions of each body part are a feature of the collapsed base, and only slightly adjusted during shaping. In order to accomplish this, the designer may have to fold several test designs before settling on a final design.

When designing, keep in mind the main components that define a model: the outline of the figure, the lines on the surface of the model, and the direction and hierarchy of the layers. The outline of the folded figure, whether it is flat or three-dimensional, should proportionally match the outline of the subject. The lines—edges of layers, flaps, etc.—on the surface of the model should represent the subject's physiology by marking out features such as muscles or color changes. For example, the surface lines on the body of a simpler fish might follow the lateral line, whereas the lines on a more complex fish might represent scales. A great design should avoid unnecessary or misplaced lines—ones that don't represent a specific characteristic of the subject. In addition, the hierarchy and direction of the layers are important. These should be intuitive, and again, based on the physiology of the subject. For example, the head layers in a fish design should be above the body layers.

Designing origami relies heavily on all the folded patterns and structures you can recall. This collection I call the design inventory. These structures can range from simple 22.5° squashes to multi-structured patterns that can be used for certain parts of a model. The more you design and fold, the more you expand your inventory. By folding from different designers, you can learn what recurring structures are used in different styles of design. You can also discover them by freefolding or designing.

Designing origami can be quite difficult. If you have trouble with a design, take a break and come back to it later. At the end of the day, be patient, and don't be discouraged if you don't succeed at first.





The Design Process

There are many methods to design origami; the process explained here is a general method to design realistic figurative models.

First, thoroughly research your subject. Note every detail: proportions, characteristics, colors, etc. You can also brainstorm ideas on how you want specific parts to look and sketch a basic figure.

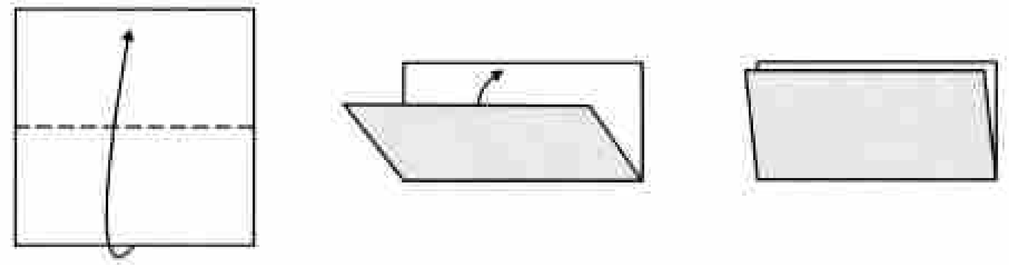
The next task is to visualize and distribute the various parts of the figure efficiently across the square sheet of paper. With a sheet of paper in front of you, identify possible configurations of the parts that can fit efficiently in the square. You can mark and label the areas with a pencil. Try to make the positions and proportions as reasonable as possible, and make sure you are not leaving any one part out. If there are multiple configurations to distribute the parts across the paper, choose the most intuitive first, then test out the others.

Next, the objective is to design the base. You can choose a style, such as 22.5° or boxpleating, and begin folding precreases so that the paper can be collapsed according to the configuration determined in the previous step. Fold enough precreases so that you can minimize the number of times you have to unfold and refold the partially collapsed base. Not all the precreases will be used. Start collapsing the sheet of paper into a base—constructing various parts of the figure and adding more creases as you progress. You may need to test the other configurations if the initial one does not collapse efficiently. During this process, fold as many variations as necessary. You will likely have to adjust the ratios or grid to correct the proportions. Once you have a satisfactory base, you can continue on to the next step, shaping.

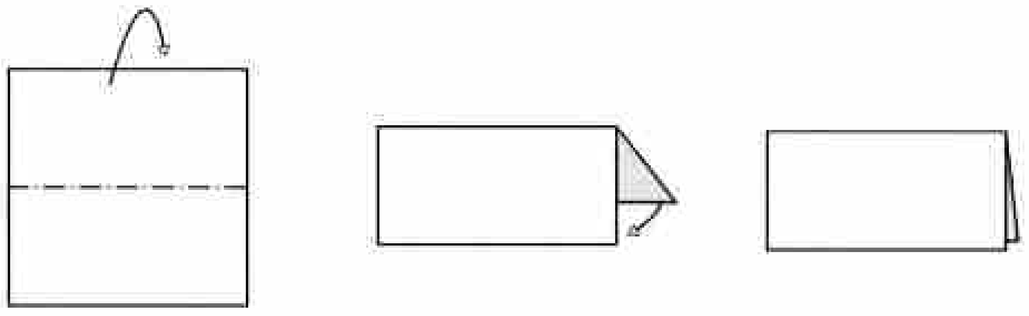
In the shaping stage of design, you can add details to the individual elements of the base. Some models may require significant shaping; others may require minimal shaping. Refold the model multiple times, refining each version until you are pleased with the results.

Once the shaping details have been fully developed, the final version of the design will be ready to be folded with high quality paper. Complete the piece by adding internal supporting wires, a base, etc.

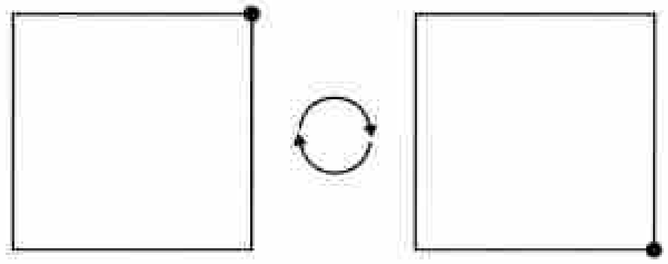
Symbols



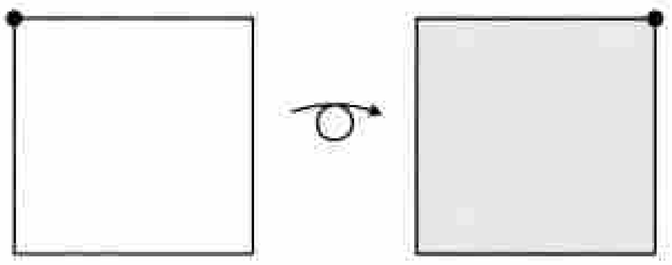
Valley Fold



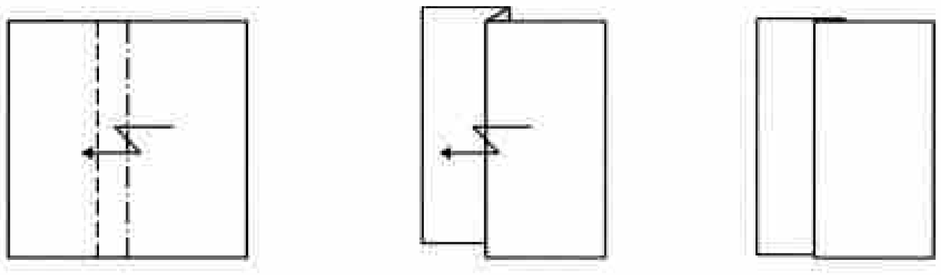
Mountain Fold



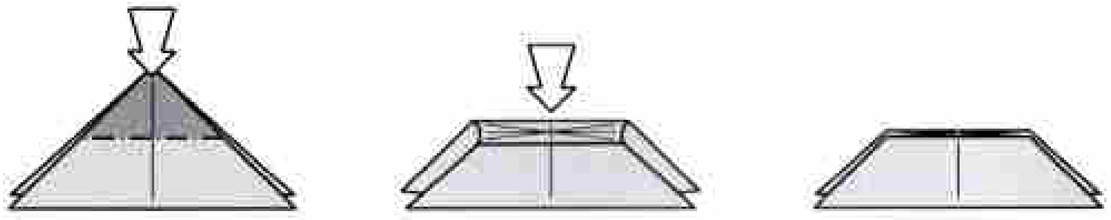
Rotate



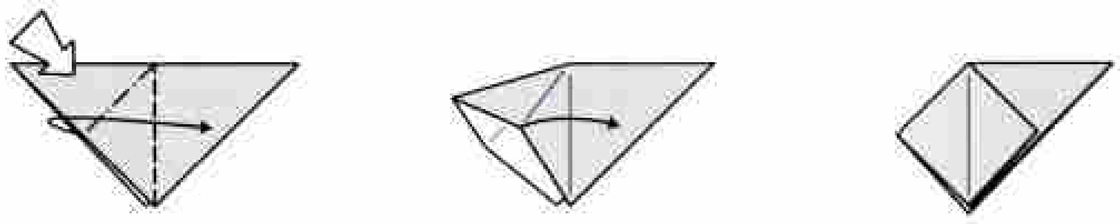
Flip Over



Pleat



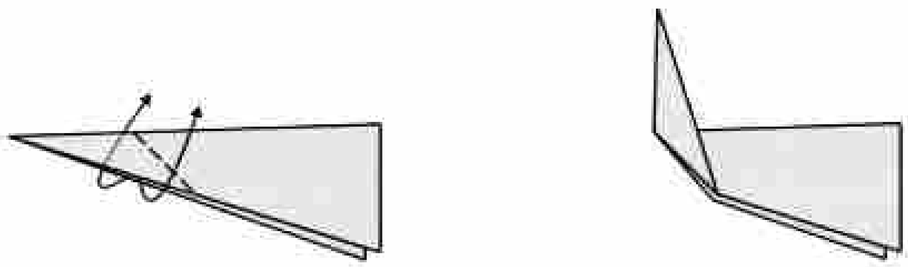
Open Sink



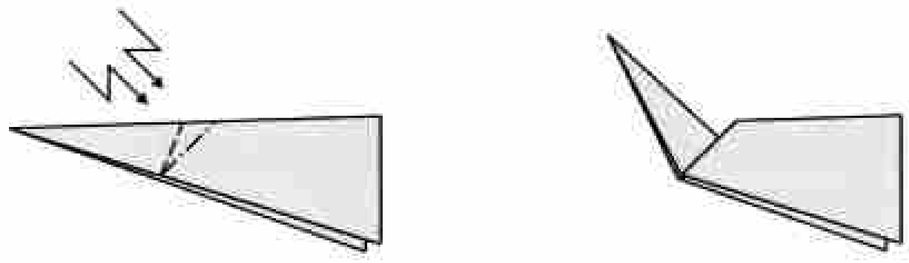
Squash



Inside Reverse Fold



Outside Reverse Fold



Crimp

Acknowledgments

Bruce Gemmell

For supporting me and test folding my designs

Dang Chau

For graphic design work

Mai Saito

For graphic design work

Kendall Younglund

For taking photos

Michael Wibowo

For editing the book

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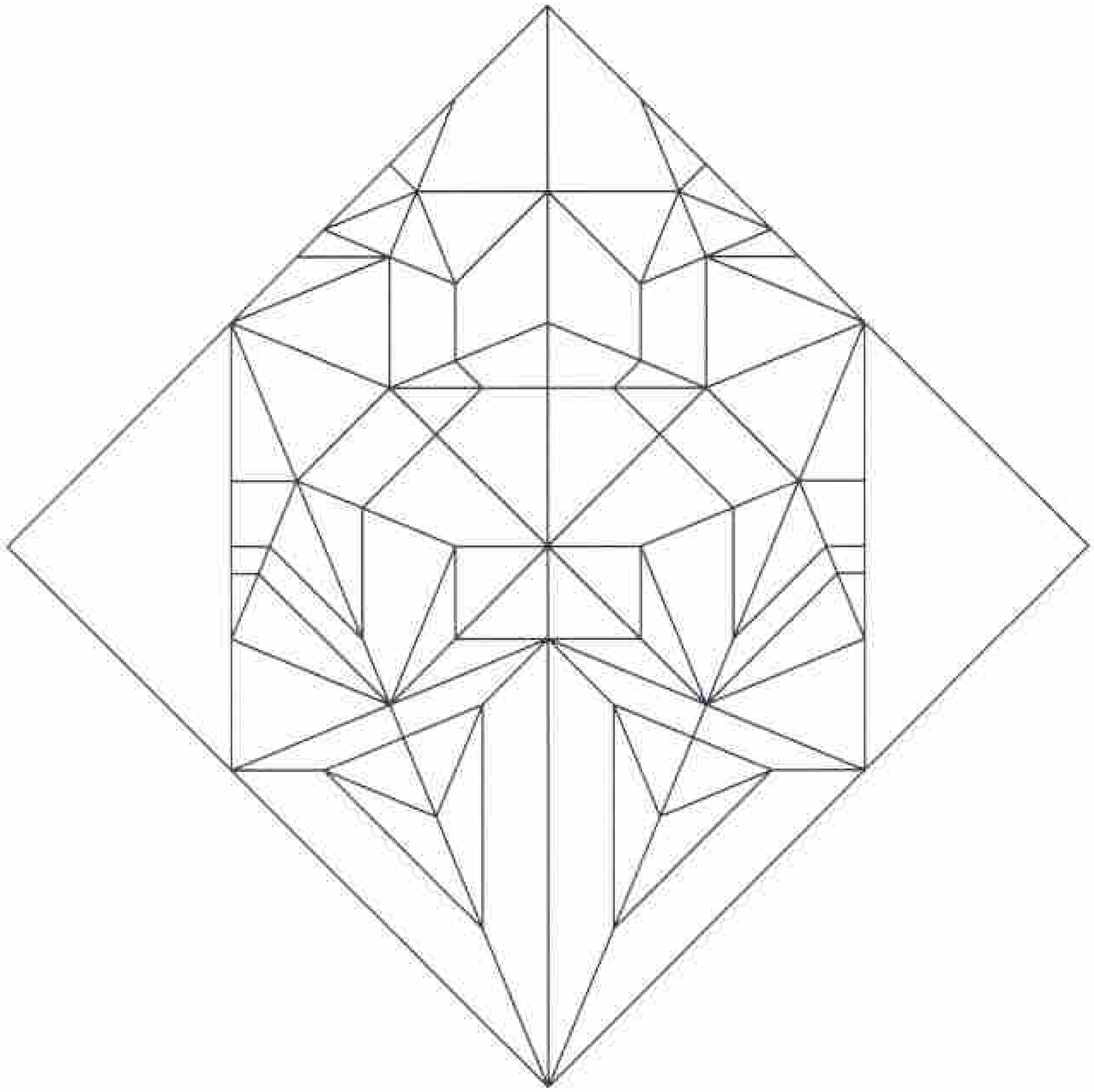
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Independently published

ISBN 978-0-578-37956-2

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ISBN 978-0-57-837956-2